



(11) Publication number:

0 208 470
A2

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 86304933.4

(51) Int. Cl.⁴: **H 03 J 5/02**
H 03 J 7/18, H 03 J 3/06

(22) Date of filing: 25.06.86

(30) Priority: 02.07.85 JP 145505/85
02.07.85 JP 145513/85(43) Date of publication of application:
14.01.87 Bulletin 87/3(84) Designated Contracting States:
DE FR GB(71) Applicant: **Matsushita Electric Industrial Co., Ltd.**
1006, Oaza Kadoma
Kadoma-shi Osaka-fu, 571(JP)(72) Inventor: **Sakashita, Seiji**
1-840-405, Otokoyamaishishiro
Yawata-shi Kyoto-fu, 614(JP)(72) Inventor: **Fukui, Kiyotake**
15-2, Higashisyoujaku
Settsu-shi Osaka-fu(JP)(74) Representative: **Crawford, Andrew Birkby et al,**
A.A. THORNTON & CO. Northumberland House 303-306
High Holborn
London WC1V 7LE(GB)(64) **Signal receiver with tuning circuits.**

(57) A signal receiver generates a reference signal that sweeps frequencies of desired channel bands, and then feeds the reference signal to an input terminal of receiver unit via a signal-switching circuit that performs switching of the desired-channel signal and the reference signal. The signal receiver then detects the signal strength present in plural frequencies of intermediate frequencies delivered to an output terminal of the reference signal, and after storing detected signal data in a memory, the signal receiver compares the detected signal data to aimed frequency characteristics. Then, the signal receiver determines tuning voltages of respective tuning circuits so that difference arose from the comparison can be minimized. After determining the tuning voltages, these voltages are delivered to respective tuning circuits, and then switching operation between the reference signal and the desired channel signal is executed before the signal receiver eventually receives the switched signal.

EP 0 208 470 A2

TITLE MODIFIED
-- front Page

0208470

SIGNAL RECEIVER

1. Field of the Invention

The present invention relates to a signal receiver which is significantly effective for use with a tuner.

2. Prior Arts and Problems

Any conventional signal receivers, in particular, the signal receiver which is provided with tuning circuits using varactor diodes feeds identical voltage to respective tuning circuits, and thus, due to different capacitances between varactor diodes, there is a considerable difference between frequency characteristics of respective tuning circuits. To compensate for this, one of the prior arts had proposed a specific constitution related to the independent control over respective tuning circuits for maximizing output of intermediate frequencies by feeding tuning voltages to individual varactor diodes in order that tuning circuits can be

provided with the best frequency characteristics. This art is expressly disclosed by the Japanese Patent Publication No. 58-18008 and presented by the technical publication "COMPUTER CONTROLLED TELEVISION CHANNEL SELECTION AND TUNER ALIGNMENT", written by Daniel Dumont and Arno Neelen; IEEE ICCE85 SESSION V - TV SIGNAL PROCESSING II, DIGEST OF TECHNICAL PAPERS, June, 1985, respectively.

However, the circuit constitution proposed by this prior art causes output of intermediate frequencies to be controlled only in the maximizing direction and seeks maximum power within the output signal bands. consequently, there is no room for identifying whether frequency characteristics of respective tuning circuits exactly match ideal characteristics within the output signal bands, or not. Although the proposed art improves power gain and signal-to-noise (S/N) ratio, signals may distort themselves due to inclined frequency characteristics within the output signal bands.

SUMMARY OF THE INVENTION

A primary object of the present invention is to provide a novel signal receiver which first detects

variation of frequency characteristic of the signal receiver within receivable signal bands caused by gain control and variation of said frequency characteristics between channels by applying a plurality of frequencies, followed by control of frequency characteristics so that the best characteristics can be generated, while the signal receiver reflecting the present invention dispenses with severe suppression of error of tuning elements and features significantly improved performance characteristics and productivity as well.

To securely realize the above object, the present invention provides a signal receiver featuring the following functional constitution: First, the signal receiver related to the present invention generates a reference signal that sweeps frequencies of desired channel bands, and then feeds said reference signal to an input terminal of receiver unit via a signal-switching circuit that performs switching of the desired-channel signal and the reference signal. The signal receiver then detects the signal strength present in plural frequencies of intermediate frequencies delivered to an output terminal of said reference signal, and after storing the detected signal data in a memory, the signal receiver compares the detected signal data to

aimed frequency characteristics. Then, the signal receiver determines tuning voltages of respective tuning circuits so that difference arose from said comparison can be minimized. After determining the tuning voltages, these voltages are delivered to respective tuning circuits, and then switching operation between the reference signal and the desired channel signal is executed before said signal receiver eventually receives the switched signal.

By realizing the system constitution mentioned above, the signal receiver reflecting the present invention can securely achieve the aimed frequency characteristics, and as a result, frequency characteristics of signals within receivable bands can be improved significantly. In addition, said signal receiver can effectively eliminate deterioration of frequency characteristics within receivable bands caused by error of tuning elements, variation of frequency characteristics while controlling gains, and channel-to-channel error. Thus, the present invention provides an extremely useful signal receiver featuring the significantly improved performance characteristics and productivity.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be better understood from the detailed description given herein below and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present invention wherein:

FIG. 1 is a simplified block diagram of the circuit making up the signal receiver using reference signals generated by oscillation of oscillator within the desired channel band reflecting the first preferred embodiment of the present invention;

FIG. 2 is a simplified block diagram of the circuit making up the signal receiver which uses reference signals comprised of signals generated within the desired channel bands by applying the integration of signals oscillated by the primary and local oscillators reflecting the second preferred embodiment of the present invention;

FIG. 3 is a flowchart related to the sequential operations of the signal receiver in conjunction with the first preferred embodiment of the present invention;

FIG. 4 is a chart denoting the basis of identifying frequency characteristics of the signal receiver related to the first preferred embodiment of the present invention;

FIG. 5 is a schematic circuit diagram related to means for generating sweep signals comprised of the primary oscillator and signal-level controller circuit reflecting another preferred embodiment;

FIG. 6 is a schematic diagram of the circuit comprised of means for generating sweep signals, primary oscillator, and the signal-level controller type mixer reflecting a still another preferred embodiment;

FIG. 7 is a schematic diagram of the signal-level controller circuit of sweep-signal generating means, which is comprised of two units of diodes, reflecting a still further preferred embodiment;

FIG. 8 is a schematic diagram of the signal-level controller circuit of sweep-signal generating means, which is comprised of two units of transistors, reflecting a still further preferred embodiment;

FIG. 9 is a schematic diagram of the signal-level controller type of sweep-signal generating means, which is comprised of four units of transistors, reflecting a still further preferred embodiment;

FIG. 10 is a schematic diagram of the signal-level controller type mixer of sweep-signal generating means,

which is comprised of four units of transistors, reflecting a still further preferred embodiment;

FIG. 11 is a schematic diagram of the signal-level controller type mixer of sweeping means, which is comprised of three units of transistors and a piece of diode, reflecting a still further preferred embodiment;

FIG. 12 is a chart denoting the relationship of frequencies of a variety of signals when the primary oscillator oscillates itself within the desired channel bands in conjunction with the first preferred embodiment;

FIG. 13 is a chart denoting the relationship of frequencies of respective signals when the primary oscillator oscillates within the desired channel bands related to another preferred embodiment derived from the first preferred embodiment;

FIG. 14 is a chart denoting the relationship of frequencies of respective signals when the primary oscillator oscillates within intermediate frequency bands and frequency oscillated by the local oscillator is stationary reflecting the second preferred embodiment;

FIG. 15 is a chart denoting the relationship of frequencies of respective signals when the primary oscillator

oscillates within a specific band corresponding to the sum of frequency oscillated by local oscillator and the desired channel reflecting another preferred embodiment derived from the second preferred embodiment;

FIG. 16 is a chart denoting the relationship of frequencies of respective signals when the primary oscillator oscillates within the intermediate frequency band and frequency oscillated by local oscillator executes sweeping operation reflecting still another preferred embodiment derived from the second preferred embodiment;

FIG. 17 is a chart denoting the relationship of frequencies of respective signals when the primary oscillator oscillates within a specific band corresponding to the sum of frequencies oscillated by local oscillator and the desired channel and frequency oscillated by said local oscillator executes sweeping operation reflecting still further embodiment derived from the second preferred embodiment;

FIG. 18 is a schematic block diagram of the circuit of another preferred embodiment, in which means for detecting signal level of intermediate frequency is comprised of sampling filter, detector, and the A/D converter;

FIG. 19 is a schematic block diagram of the circuit of still another preferred embodiment, in which sampling filter of means for detecting signal level of intermediate frequency is comprised of frequency-fixing filters which are connected to each other in parallel;

FIG. 20 is a schematic block diagram of the circuit of still another preferred embodiment, in which sampling filter of means for detecting signal level of intermediate frequency is comprised of a frequency-fixing filter;

FIG. 21 is a schematic block diagram of the circuit of a still further preferred embodiment, in which sampling filter of means for detecting signal level of intermediate frequency is comprised of frequency-variable filter;

FIG. 22 is a schematic block diagram of the circuit of one of the preferred embodiments, in which sampling filter of means for detecting signal level of intermediate frequency is comprised of a plurality of saw-toothed filters;

FIG. 23 is a schematic block diagram of the circuit of another preferred embodiment, in which sampling filter of means for detecting signal level of intermediate frequency is comprised of a saw-toothed filter;

FIG. 24 is a schematic block diagram of the circuit of a still further preferred embodiment, in which sampling filter of means for detecting signal level of intermediate frequency is comprised of windings and varactor diodes;

FIG. 25 is a schematic block diagram of the circuit of one of the preferred embodiments, in which means for detecting signal level of intermediate frequency is comprised of an A/D converter and a digital filter;

FIG. 26 is a schematic block diagram of the circuit of a still further preferred embodiment, in which means for detecting signal level of intermediate frequency is comprised of a CCD filter and an A/D converter;

FIG. 27 is a schematic block diagram of the circuit of one of the preferred embodiments, in which D/A converters of tuning voltage supply means are connected to each other in parallel by the number identical to that of tuning circuit;

FIG. 28 is a schematic block diagram of the circuit of one of the preferred embodiments, which is comprised of one unit of D/A converter;

FIG. 29 is a schematic block diagram of the circuit of one of the preferred embodiments, in which the first signal switching circuit is comprised of two pieces of diodes.

FIG. 30 is a schematic block diagram of the circuit of one of the preferred embodiments, in which the first signal switching circuit is comprised of four pieces of transistors;

FIG. 31 is a schematic block diagram of the circuit of one of the preferred embodiments, in which the second signal switching circuit is comprised of two pieces of diodes;

FIG. 32 is a schematic block diagram of the circuit of one of the preferred embodiments, in which the second signal switching circuit is comprised of four pieces of transistors;

FIG. 33 is a schematic block diagram of the circuit of one of the preferred embodiments, in which AGC voltage retention means is comprised of two pieces of transistors and a capacitor;

FIG. 34 is a schematic block diagram of the circuit of one of the preferred embodiments, in which AGC voltage

retention means is comprised of a D/A converter, a resistor and an A/D converter;

FIG. 35 is a simplified block diagram of the circuit making up control means; and

FIG. 36 is a simplified block diagram of the circuit of one of the preferred embodiments, in which the primary oscillator is made available for another local oscillator.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the accompanying drawings, the first preferred embodiment of the present invention is described below. In FIG. 1, using frequency conversion means, receiving circuit 1 (R-circuit, hereinafter) converts signal of the desired channel into a specific intermediate frequency. Said R-circuit 1 is comprised of input tuning circuit 12, radio-frequency (RF) amplifier 13, interstage tuning circuit 14, mixer 15 and local oscillator 16, respectively. signal of the desired channel band is delivered to radio-frequency amplifier 13 via input tuning circuit 12, where said radio-frequency amplifier 13 allows the gain of signal to vary in proportion to the AGC voltage. The amplified signal is then delivered to

interstage tuning circuit 14 which eliminates signal of the image-band, and then mixer 15 mixes said signal with the signal oscillated by local oscillator 16, and as a result, intermediate frequency signal is generated from the output terminal of mixer 15. Since double tuning circuit is often made available for said interstage tuning circuit, at least two systems of the tuning voltage are necessary.

By activating channel-select command means 10 and channel-select control means 9, desired channel is selected by feeding the identical tuning voltages to input tuning circuit 12, interstage tuning circuit 14, and local oscillator 16 before eventually receiving signals from the selected channel. The desired channel signal is received from terminal 11, and then signal switching circuit 3 functions so that control means 9 can deliver signal from R-circuit 1 to the following input tuning circuit 12 of R-circuit 1.

R-circuit 1 then converts the received signal into intermediate frequency signal, which is then delivered to signal switching circuit 4. Signal switching circuit 4 functions to allow control means 9 to deliver signal from R-circuit 1 to the following intermediate frequency (IF) amplifier/demodulator 6. Intermediate frequency signal which passed through

signal switching circuit 4 is then amplified and detected by intermediate frequency amplifier/demodulator 6 before being delivered to the following signal processing circuit. Intermediate frequency amplifier/demodulator 6 generated AGC voltage for delivery to AGC-voltage hold means 5, which then delivers this voltage to radio-frequency amplifier 13 and sweep signal generator 2.

AGC-voltage hold means 5 holds AGC voltage corresponding to the desired channel signal level for a specific duration, and then control means 9 delivers control signal to signal switching circuit 3, where signal from said sweep signal generating means 2 is subjected to switching before being sent to input tuning circuit 12 of R-circuit 1, and finally reference signal of the desired channel band generated by said sweep signal generating means 2 is delivered to R-circuit 1. Simultaneously, reference signal having a specific level corresponding to the AGC voltage from AGC voltage hold means 5 is also supplied to R-circuit 1. After being delivered to R-circuit 1, the reference signal is then subjected to frequency-conversion before being delivered to signal switching circuit 4. Signal switching circuit 4 is then switched by control means 9 so that

intermediate frequency signal can be led to intermediate-frequency signal level detection means 8, which then converts intermediate frequency signal into DC signal corresponding to the detected signal level. The DC signal is then binary-coded before being delivered to control means 9. Using the binary-coded DC-level signal, control means 9 computes the signal level of a plurality of frequencies present in R-circuit 1 for detecting frequency characteristics, and then it causes the tuning voltages of input tuning circuit 12 and interstage tuning circuit 14 to slightly vary themselves in the direction of reducing difference from the aimed frequency characteristics, and finally, it outputs the varied tuning voltage through tuning-voltage delivery means 7. If these frequency characteristics in R-circuit 1 were still different from the aimed frequency characteristics, control means 9 causes tuning voltage to vary themselves furthermore until all the frequency characteristics eventually match each other. When these frequency characteristics exactly match the aimed one, control means 9 stores respective tuning voltages in memory, and then it causes signal switching circuits 3 and 4 to be switched in the direction of receiving the desired channel signal. On the

other hand, AGC-voltage hold means 5 discontinues retention of AGC voltage and directly delivers it to radio-frequency amplifier 13 and sweep-signal generating means 2 without holding AGC voltage from intermediate-frequency amplifier/demodulator 6 and maintains this state until starting to select the desired channel again.

According to the first preferred embodiment of the present invention, since the system retains a specific AGC voltage corresponding to the field intensity while receiving the desired-channel signal and compares the level deviations between a plurality of frequencies, compared to the conventional provision of tuning voltages for merely seeking the maximum point of intermediate-frequency signal level, the signal receiver reflecting the first preferred embodiment of the present invention not only correctly receives the desired-channel signals using the significantly improved performance characteristics, but it also securely suppresses error generated by the tuning circuit even when respective tuning elements function with erroneous components.

Next, referring to the accompanying drawings, the second preferred embodiment of the present invention is described below. In FIG. 2, R-circuit 1 converts the

desired-channel signal into a specific intermediate frequency by applying frequency-conversion means. R-circuit 1 is comprised of input tuning circuit 12, radio-frequency amplifier 13, interstage tuning circuit 14, mixer 15, and local oscillator 16, respectively. Signal of the desired channel band is delivered to radio-frequency amplifier 13 via input tuning circuit 12. After amplification, interstage tuning circuit 14 eliminates signals present in the image-band, while genuine signal components are then mixed together with oscillated signal from local oscillator 16 by means of mixer 15, which then outputs a specific intermediate frequency signal. Since double tuning circuits are often made available for the interstage tuning circuit, at least two systems of tuning voltages are necessary.

By activating channel-select command means 10 and channel-select control means 9, desired channel is selected by feeding the identical tuning voltages to input tuning circuit 12, interstage tuning circuit 14, and local oscillator 16 before eventually receiving signals from the selected channel. The desired channel signal is received from terminal 11, and then signal switching circuit functions so that control means 9 can deliver signal from

R-circuit 1 to the following input tuning circuit 12 of R-circuit

1. Receiver 1 then converts the received signal into intermediate frequency signal, which is then delivered to signal switching circuit 4. Signal switching circuit 4 functions to allow control means 9 to deliver signal from R-circuit 1 to the following intermediate frequency amplifier/demodulator 6. Intermediate frequency signal which passed through signal switching circuit 4 is then amplified and detected by intermediate frequency amplifier/demodulator 6 before being delivered to the following signal processing circuit. Intermediate frequency amplifier/demodulator 6 generates AGC voltage for delivery to radio-frequency amplifier 13 and sweep signal generator 2.

AGC-voltage hold means 5 holds AGC voltage corresponding to the desired channel signal level for a specific duration, and then control means 9 delivers control signal to signal switching circuit 3, where signal from said sweep signal generating means 2 is subjected to switching before being sent to input tuning circuit 12 of R-circuit 1, and finally reference signal of the desired channel band generated by said sweep signal generating means 2 is delivered to R-circuit 1, where reference signal of the desired

channel band is generated by applying part of oscillated signal from local oscillator and differential frequency from the primary oscillator of sweep signal generating means 2 of R-circuit 1. Simultaneously, reference signal having a specific level corresponding to the AGC voltage from AGC-voltage hold means 5 is also supplied to R-circuit 1. After being delivered to R-circuit 1, the reference signal is then subjected to frequency-conversion before being delivered to signal switching circuit 4. Signal switching circuit 4 is then switched by control means 9 so that intermediate frequency signal can be led to intermediate-frequency signal level detection means 8, which then converts intermediate frequency signal into DC signal corresponding to the detected signal level. The DC signal is then binary-coded before being delivered to control means 9. Using the binary-coded DC-level signal, control means 9 computes the signal level of a plurality of frequencies present in R-circuit 1 for detecting frequency characteristics, and then it causes the tuning voltages of input tuning circuit 12 and interstage tuning circuit 14 to slightly vary themselves in the direction of reducing difference from the aimed frequency characteristics, and finally, it outputs the

varied tuning voltage through tuning-voltage delivery means 7. If these frequency characteristics in R-circuit 1 were still different from the aimed frequency characteristics, control means 9 causes tuning voltage to vary themselves furthermore until all the frequency characteristics eventually match each other. When these frequency characteristics exactly match the aimed one, control means 9 stores respective voltage values in memory, and then it causes signal switching circuits 3 and 4 to be switched in the direction of receiving the desired channel signal. On the other hand, AGC-voltage hold means 5 discontinues retention of AGC voltage and directly delivers it to radio-frequency amplifier 13 and sweep-signal generating means 2 without holding AGC voltage from intermediate-frequency amplifier/demodulator 6 and maintains this state until starting to select the desired channel again.

According to the second preferred embodiment of the present invention, since the system retains a specific AGC voltage corresponding to the field intensity while receiving the desired-channel signal and compares the level deviation between a plurality of frequencies, compared to the conventional provision of tuning voltages for merely seeking the

maximum point of intermediate frequency signal level, the signal receiver reflecting the second preferred embodiment of the present invention not only correctly receives the desired channel signal using the significantly improved performance characteristics, but it also securely suppresses error generated by the tuning circuit even when respective tuning elements function with erroneous components.

FIG. 3 represents the chart describing the sequential procedure needed for controlling tuning operation related to the first preferred embodiment using control means 9. While R-circuit 1 operates for receiving the desired channel signal, the system remains in identifying routine 17, where the system stands by for receiving channel (Ch)-select command from channel-select command means 10. When changing the desired-channel signal, i.e., when changing it to another channel, channel-select command means outputs the binary-coded channel control signal. After detecting this signal in the identifying routine 17, as shown in routine 18, control means 9 delivers a specific tuning voltage corresponding to the desired channel to local oscillator 16 of R-circuit 1. When routine 19 is entered, control means provides input tuning circuit 12 and interstage tuning circuit 14 with

tuning voltages having specific potentials identical to the tuning voltage fed to said local oscillator 16. This allows R-circuit 1 to receive the desired channel, and thus, mixer 15 outputs intermediate frequency signals. This signal then passes through signal switching circuit 4 before being demodulated by intermediate-frequency amplifier/demodulator 6. Said amplifier/demodulator 6 then delivers a specific AGC voltage corresponding to the desired channel signal level to AGC-voltage hold means 5. When routine 20 is entered, AGC voltage is retained so that gain of radio-frequency amplifier 13 and the output level of sweep-signal generating means 2 can be held constant. This activated routine 21, in which signal-switching circuit 3 is switched to sweep-signal generating means 2, and likewise, signal switching circuit 4 is switched to intermediate-frequency signal level detection means 8. When routine 22 is entered, tuning-voltage delivery means 7 delivers a specific tuning voltage to allow sweep-signal generating means 2 to sweep frequencies within the desired channel frequency band.

This activates routine 23, in which either the input tuning circuit 12 or the interstage tuning circuit 14 is selected. For example, the system selects input tuning circuit 12 before proceeding to routine 24. When routine 24 is

entered, only the tuning voltage delivered to input tuning circuit 12 is varied to a level close to the lowest frequency within the desired channel frequencies. When routine 25 is entered, intermediate-frequency signal level detection means 8 detects the signal levels of plural frequencies in the desired channel frequency band from the intermediate frequency signals corresponding to these frequencies. When routine 26 is entered, only the tuning voltage delivered to input tuning circuit 2 is slightly varied before detecting signal levels by applying procedure identical to that is executed during routine 25.

By designating data of signal levels detected during routine 25 to be the N-th data of signal levels detected during routine 26 to be the N+1th data, routine 28 identifies whether the aimed frequency characteristics are achieved, or not. If the aimed frequency characteristics were achieved, routine 29 is entered. conversely, if these characteristics were not yet realized, system operation is again back to routine 25 to be followed by routines 26 and 27 before proceeding to routine 28 over again. When routine 29 is entered, control means 9 stores the binary-coded tuning voltage data fed to input tuning circuit 12 in memory to

complete provision of tuning voltage for input tuning circuit 12. However, since interstage tuning circuit 14 still needs to be provided with the tuning voltage, operation mode returns to routine 23 from routine 30, by applying the selected tuning circuit to be one of tuning circuits of interstage tuning circuit 14, operation mode again sequentially proceeds to routines 24 through 29. In the same way, after control means 9 fully stores data related to tuning voltages in memory, operation mode proceeds from identifying routine 30 to routine 31, in which signal switching circuits 3 and 4 and AGC-voltage hold means 5 are respectively provided with the desired-channel signal receivable condition so that they can respectively receive desired-channel signals. This causes the operation mode to be back to routine 17, and as a result, control means 9 causes the system to follow up stand-by mode until the next channel-selection command is generated.

FIG. 4 represents the chart related to one of preferred embodiments of designating the identification basis when executing identifying routine 28 of tuning control means shown in FIG. 3. The N-th and N+1th data detected by routines 25 and 26 are delivered to control means 9, which then

checks to see the maximum values compared between respective center frequencies present in the desired-channel frequency bands and the flatness of more than two units of frequencies. In particular, since the flatness of frequency characteristics present in R-circuit 1 precedes the maximum value, independent of the magnitude of the maximum values of the N-th and N+1th data, if the N-th data proves to be flat, the system introduces the N-th data. Conversely, if the N-th data proves to degrade the flatness of frequency characteristics, identification (ID) step 2 is entered, in which only when the N+1th data proves to ensure flatness of frequency characteristics, the system introduces either of the N-th and N+1th data whichever designates the maximum value. However, while said identification step 2 is still underway, if N+1th data proves that no flatness is achieved for frequency characteristics, both the N-th and N+1th data are identified to be defective for use, and then, the system proceeds to further routines so that tuning voltage is subjected to fine variations furthermore.

FIGs 5 through 11 respectively denote typical embodiments of the present invention in conjunction with sweep-signal generating means of the signal receiver.

Sweep-signal generating means shown in FIG. 5 is comprised of primary oscillator 33 and signal-level controller circuit 32. Tuning voltage delivery means 7 delivers a specific tuning voltage to sweep-signal generating means so that oscillator 33 can securely oscillates itself within the desired-channel frequency band to correctly sweep frequencies. Signal oscillated by oscillator 33 is delivered to said signal-level controller circuit 32. AGC-voltage hold means 5 feeds AGC voltage to said signal-level controller circuit 32 so that the delivered signals can be set to the predetermined level corresponding to the AGC voltage before eventually being delivered to signal switching circuit 3 as the reference signal. Using the system shown in FIG. 5, reference signal can easily be generated.

FIG. 6 represents another preferred embodiment of sweep-signal generating means of the signal receiver related to the present invention, which is comprised of the primary oscillator 33 and signal-level control-type mixer 34. Tuning voltage delivery means 7 delivers a specific tuning voltage so that said oscillator 33 can oscillates itself within a specific frequency band corresponding to either the intermediate frequency band or the sum of the oscillated

frequency generated by local oscillator 16 and the desired channel frequency, while signal oscillated by the primary oscillator 33 and part of signal oscillated by local oscillator 16 are respectively delivered to signal-level control type mixer 34. AGC-voltage hold means 5 feeds a specific AGC voltage to said signal-level control type mixer 34, which is then set to a specific signal level corresponding to the level of AGC voltage before being delivered to signal-switching circuit 3 as the reference signal. By introducing the system shown in FIG. 6, intermediate frequency signal can be made available either for the stationary frequency or sweeping frequency, and yet, it is possible for the system to freely make up the constitution of intermediate-frequency signal level detection means.

Primary oscillator 33 shown in FIG. 7 is provided with varactor diode 37 that makes up tank circuit in the base electrode of transistor 40 via capacitor 39 and parallel resonance circuit made of coil 38, which are respectively connected to each other between grounds. Cathode of varactor diode 37 is grounded by capacitor 36, while tuning voltage delivery means 7 feeds a specific tuning voltage oscillated in the desired-channel frequency band to the

cathode-capacitor connected point via resistor 35. Capacitors 43 and 44 are substantially feedback capacitors, oscillating frequency is determined by varactor diode 37, capacitors 43, 44 and 39, and coil 38. Resistors 41 and 45 respectively bias said transistor 40, while collector electrode of this transistor is grounded via capacitor 42. Oscillated signals are fed to cathode of diode 48 of signal-level controller circuit 32 via DC-blocking capacitor 46. Anodes of diodes 48 and 49 are connected to each other, while the oscillated signals from cathode of diode 49 is delivered to signal-switching circuit 3 via capacitor 51. Collector electrode of transistor 55 is connected to the connection point of anodes of diodes 48 and 49 via resistor 52, whereas base electrode of said transistor 55 is provided with AGC voltage which is delivered from AGC-voltage hold means 5 via resistor 54. Emitter electrode of said transistor 55 is connected to power-supply source via resistor 54. Cathodes of diodes 48 and 49 are respectively grounded via resistors 47 and 50. In response to the AGC voltage from AGC-voltage hold means 5, current flowing through collector of transistor 55 varies to cause the insertion loss of said diodes 48 and 49 to also vary, and as a

result, level of the oscillated signal delivered to said signal-switching circuit 3 also varies. The system shown in FIG. 7 features simple circuit constitution and effectively functions when oscillator 33 oscillates high-level signals.

Primary oscillator shown in FIG. 8 has the constitution and functions exactly identical to those which are explained in the above description related to FIG. 7, and therefore, detailed description is deleted. Oscillated signal is first delivered to signal-level controller circuit 32 via capacitor 46, which is then fed to base electrode of transistor 61. Emitter electrode of transistor 61 is grounded, whereas biasing resistor 60 is connected between base-and-collector electrodes and resistor 58 between collector electrode and power-supply source, respectively. Collector electrode of transistor 61 is connected to collector electrode of transistor 56. Emitter electrode of transistor 56 is grounded via resistor 57. AGC-voltage hold means 5 feeds AGC voltage to base electrode of transistor 56 via resistor 53. When AGC voltage rises, collector potential of transistor 56 lowers, and at the same time, bias voltage of transistor 61 also lowers to lower gain, and eventually causes the level of oscillated signal to lower before delivery to signal-

switching circuit 3. When the AGC voltage is high, gain of radio-frequency amplifier 13 also rises to lower the level of oscillated signal. Conversely, when the AGC voltage is low, gain of radio-frequency amplifier 13 is also low, thus high-level oscillated signal is fed. This level is proportional to the signal level of desired channel. The system described above uses transistor which is provided with amplifying function, thus making it possible for the system to lower the level of signal oscillated by said oscillator 33, which in turn usefully serves for preventing unnecessary radiation and spurious jamming as well.

Primary oscillator 33 shown in FIG. 9 oscillates at a specific frequency band higher than those which are oscillated by oscillators shown in FIGs 7 and 8. Base electrode of transistor 66 is connected to resonance circuit comprised of capacitor 67, tuning line 71, and varactor diode 69 between grounds via capacitor 68. Tuning-voltage delivery means 7 delivers a specific tuning voltage to the contact point of capacitors 67 and 68 and tuning line 71 via resistor 35, in which said tuning voltage oscillates either in the intermediate frequency band or in a specific frequency band corresponding to the sum of the oscillated frequency

of local oscillator 16 and the desired-channel frequency. Capacitors 64 and 65 are substantially feedback capacitors. Resistors 62 and 65 respectively bias transistor 66, while collector electrode of this transistor is grounded via capacitor 63. Oscillated signal is fed to line 70 from tuning line 71 by means of magnetic-field coupling and then delivered to base electrode of transistor 73 of signal-level control-type mixer 34 via DC block capacitor 46. Emitter electrodes of transistors 73 and 74 are connected to each other, whose contact point is connected to collector electrode of transistor 81. On the other hand, emitter electrode of transistor 81 is connected to emitter electrode of transistor 80, while collector electrode of transistor 80 is grounded. AGC-voltage hold means 5 delivers AGC voltage to base electrode of transistor 80 via resistor 53 to allow emitter current corresponding to AGC voltage to flow into transistor 81 via transistor 80. Local oscillator 16 delivers part of signal oscillated by itself to base electrode of transistor 81 via DC-blocking capacitor 78. Base electrode of transistor 74 is grounded via capacitor 72. Oscillated signal delivered to base electrode of said transistor 73 and part of signal oscillated by local oscillator

16 fed to base electrode of said transistor 81 are respectively mixed together in transistors 73 and 74, which then generate signals corresponding to the desired-channel frequency band. These signals are then delivered from collector electrode of said transistor 74 to signal-switching circuit 3 via DC-blocking capacitor 51. Since current flowing through emitters of transistors 80 and 81 is varied by AGC voltage, current flowing through emitters of said transistors 73 and 74 also varies, thus eventually varying the conversion gain of said mixer 34. As a result, when AGC voltage is high, emitter current lowers, thus causing the conversion gain of mixer 34 to lower, and consequently, level of reference signal lowers itself before delivery to signal-switching circuit 3. Conversely, when AGC voltage is low, level of reference signal rises, thus making it possible for the system to generate signal which is proportional to the level of desired channel signal. Resistors 75 through 77 and 82 through 84 are respectively biasing resistors, while capacitor 79 is used for grounding high frequencies. since the system shown above uses equilibrium-type signal-level controlling mixer 34, it effectively suppresses spurious jamming (disturbance).

See FIG. 10. Since the primary oscillator 33 performs operations exactly identical to those which have been described in reference to FIG. 9, detailed explanation is deleted. Signal oscillated by primary oscillator 33 is delivered to base electrode of transistor 74 of signal-level control-type mixer 34 from line 70 via DC-blocking capacitor 46. Emitter electrodes of transistors 73 and 74 are connected to each other, while collector electrode of transistor 81 is connected to the contact point of these emitter electrodes. Emitter electrode of transistor 81 is grounded, while said emitter electrode is connected to emitter/collector electrodes of transistor 85 between collector electrodes of transistors 73 and 74. AGC-voltage hold means 5 feeds AGC voltage to base electrode of transistor 85 via resistor 53 so that potentials of emitter and collector of said transistor 85 and collectors of said transistors 73 and 74 can vary in response to the delivered AGC voltage. On the other hand, local oscillator 16 feeds part of signal oscillated by itself to base electrode of said transistor 81 via capacitor 78. Base electrode of said transistor 74 grounds radio-frequency components via capacitor 72. Signal oscillated by primary oscillator 33 delivered to base

electrode of said transistor 73 and part of signal oscillated by local oscillator 16 fed to base electrode of said transistors 81 are mixed together by said transistors 73 and 74 before generating a specific signal corresponding to the desired-channel frequency band. This signal is then delivered to signal-switching circuit 3 from collector electrode of said transistor 74 via DC-blocking capacitor 51. Since potentials of emitter and collector of transistor 85 are varied by AGC voltage, collector potentials of said transistors 73 and 74 also vary themselves, and eventually varying the conversion gain of mixer 34. As a result, when the AGC voltage is high, collector potential of transistor 74 lowers as the voltage between base and emitter of said transistor 85 more significantly biases itself in the forward direction, thus causing the conversion gain of said mixer 34 to lower. Consequently, level of reference signal lowers before being delivered to signal-switching circuit 3. Conversely, when AGC voltage is low, the reference signal level rises, thus making it possible for the system to generate signal which is proportional to the desired-channel signal level. Resistors 75 through 77 and 82 through 84 are respectively biasing resistors. Since the system shown

- 35 -

capacitor 78. Base electrode of said transistor 74 grounds high-frequency components. Signal oscillated by primary oscillator 33 and fed to base electrode of said transistor 73 and part of signal oscillated by local oscillator 16 fed to base electrode of said transistor 81 is mixed together by said transistors 73 and 74. As a result, signal corresponding to the desired-channel frequency band is generated, which is then delivered to signal-switching circuit 3 from collector electrode of said transistor 74 via DC-blocking capacitor 51. When using the system shown in FIG. 11, as the AGC voltage rises, said diode 87 more significantly biases in the forward direction to lower loss of signal flowing through said diode 87. This allows signals of the desired-channel frequency band present in collector electrode of transistor 74 generated by mixing operation to cancel with each other, thus eventually lowering the level of reference signal before being delivered to signal-switching circuit 3. Conversely, when AGC voltage is low, level of reference signal rises, thus allowing the system to generate signal which is proportional to the desired-channel signal level. Resistors 75 through 77 and 82 through 84 are respectively biasing resistors. Since the system shown in

FIG. 11 uses signal-level controlling balanced mixer. 34, it effectively suppresses spurious jamming (distortion).

FIGs 12 and 13 and respectively the charts denoting the relationship of frequencies used for sweep-signal generating means 2 of the first preferred embodiment related to the present invention.

Referring now to FIG. 12, signal 89 denotes intermediate frequency signal output from R-circuit 1. Signal 90 denotes reference signal output from said sweep-signal generating means 2. Signal 91 denotes signal oscillated by primary oscillator 33, whereas signal 88 denotes signal oscillated by local oscillator 16.

Primary oscillator 33 oscillates signals by sweeping frequencies within the desired-channel frequency band. Oscillated signal level is first controlled by applying AGC voltage before being made available for reference signal. Since local oscillator 16 of R-circuit 1 oscillates itself using a stationary frequency, signal containing swept frequency appears in the intermediate-frequency band. Width and velocity of the frequency-swept signal are identical to those of signals oscillated by primary oscillator 33, however, frequency is swept in the inverse direction. The

frequency relationship shown in FIG. 12 suggests that no spurious disturbance can take place because oscillation is directly applied to signals in the desired-channel frequency band.

See FIG. 13. Since the chart refers to signals 88 through 91 which are shown in FIG. 12, detailed description is deleted.

Primary oscillator 33 oscillates signals by sweeping frequencies within the desired-channel frequency band. The level of oscillated signals is first controlled by applying AGC voltage before these signal are made available for reference signals. Since local oscillator 16 of R-circuit 1 oscillates itself by sweeping frequencies, signal containing a stationary frequency appears in the intermediate frequency band. Signal oscillated by local oscillator 16 has the same width, velocity, and direction of swept frequency as those of signals oscillated by primary oscillator 33. The frequency relationship shown in FIG. 13 suggests that no spurious disturbance can take place because oscillation is directly applied to signals in the desired-channel frequency band.

Furthermore, since the intermediate-frequency signal contains a stationary frequency, intermediate-frequency signal-level detection means 8 can easily be made up, thus providing another advantage for the system.

FIGs 14 through 17 are respectively the charts denoting the frequency relationship related to sweep-signal generating means 2 making up the second preferred embodiment of the signal receiver reflecting the present invention.

In FIG. 14, signal 88 denotes the signal oscillated by local oscillator 16. Signal 89 denotes the intermediate-frequency signal output from R-circuit 1. Signal 90 denotes the reference signal output from sweep-signal generating means 2, whereas signal 91 denotes the signal oscillated by primary oscillator 33.

Primary oscillator 33 oscillates itself by sweeping frequencies within intermediate frequency band. Local oscillator 16 of R-circuit 1 oscillates itself by applying a stationary frequency. Signals oscillated by both oscillators are then mixed together by sweep-signal generating means 2. The system uses reference signal which is substantially comprised of the differential signal of applied frequencies. As a result, R-circuit 1 outputs a specific

intermediate-frequency signal containing swept frequencies. Said intermediate-frequency signal has the same width, velocity, and direction of the swept frequency as those of signals oscillated by primary oscillator 33.

The system mentioned above allows optional frequencies within the desired-channel band of intermediate frequency band to be replaced by frequencies to be oscillated by primary oscillator 33, thus effectively eliminating the needs for identifying respective frequencies made available for intermediate frequency additionally.

See FIG. 15. Since the chart refers to signals 89 through 91 which are shown in FIG. 14, detailed explanation is deleted. Primary oscillator 33 oscillates itself by sweeping frequencies of a specific frequency band corresponding to the sum of the desired-channel frequency and the frequency oscillated by local oscillator 16. Local oscillator 16 of R-circuit 1 oscillates itself by applying a stationary frequency. Both of the oscillated signals are mixed together by sweep-signal generating means 2. The system uses reference signal which is substantially comprised of the differential signal of applied frequencies. As a result, R-circuit 1 outputs a specific intermediate-frequency

signal containing swept frequencies. Said intermediate-frequency signal has the same width, velocity, and direction of the swept frequency as those of signals oscillated by primary oscillator 33. However, frequency is swept in the direction opposite from the direction of the frequency-oscillation of oscillator 33.

In this frequency relationship shown in FIG. 15, the system allows optional frequencies within the desired-channel band of intermediate frequency band to be replaced by frequencies to be oscillated by primary oscillator 33. In addition, since the system shown in FIG. 15 raises frequencies to be oscillated by primary oscillator 33. This allows the fractional band width to be narrowed, thus making it possible for the system to make up said oscillator 33 easily.

See FIG. 16. since the chart refers to signals 88 through 91 which are shown in FIG. 14, detailed explanation is deleted.

Primary oscillator 33 oscillates itself by applying a stationary frequency of a specific intermediate-frequency band. Local oscillator 16 of R-circuit 1 oscillates itself by sweeping frequencies. Both of the oscillated signals are

mixed together by sweep-signal generating means 2. The system uses reference signal which is substantially comprised of the differential signal of applied frequencies. As a result, R-circuit 1 outputs a specific intermediate-frequency signal containing swept frequencies. Width, velocity, and direction of the swept frequency of the signal oscillated by local oscillator 16 and the reference signal are identical to each other.

In the frequency relationship shown in FIG. 16, since primary oscillator 33 oscillates itself by applying a stationary frequency and generates reference signal by causing local oscillator 16 used for channel selection to sweep frequencies, there is no need of synchronizing signals oscillated by primary oscillator 33 and local oscillator 16. In addition, since stationary frequencies are used for intermediate-frequency signals, sweep-signal generating means 2 and intermediate-frequency signal-level detection means 8 can easily be made up.

See FIG. 17. Since the chart refers to signals 88 through 91 which are shown in FIG. 14, detailed explanation is deleted.

Primary oscillator 33 oscillates itself by applying a stationary frequency of a specific frequency band corresponding to the sum of the desired-channel frequency and the frequency oscillated by local oscillator 16, whereas local oscillator 16 of R-circuit 1 oscillates itself by sweeping frequencies. Both of the oscillated signals are mixed together by sweep-signal generating means 2. Differential frequency signal is made available for reference signal. As a result, R-circuit 1 outputs intermediate-frequency signals containing swept frequencies. Width and velocity of swept frequencies of signals oscillated by local oscillator 16 and the reference signal are identical to each other except for the inversed sweeping direction. Width and velocity of swept frequencies of intermediate-frequency signal doubles those of the reference signal, while the sweeping direction is opposite from each other.

In the frequency relationship shown in FIG. 17, primary oscillator 33 oscillates itself by applying a stationary frequency and generates reference signal by causing local oscillator 16 used for channel selection to sweep frequencies. This eliminates the needs for synchronizing signals oscillated by primary oscillator 33 and local

oscillator 16, and as a result, sweep-signal generating means 2 can easily be made up. In addition, since the width of swept frequency of intermediate-frequency signal is widened twice, frequency resolution of intermediate-frequency signal-level detection means 8 is significantly improved.

FIGs 18 through 26 are respectively the schematic diagrams denoting typically preferred embodiments of intermediate-frequency signal-level detection means 8 of the signal receiver related to the present invention.

In FIG. 18, a specific intermediate-frequency signal generated by frequency-converted reference signal is first extracted from signal-switching circuit 4 for delivery to sampling filter 93, which then filters out only a specific signal containing the aimed frequency. This signal is then delivered to detector 94, which is then converted into a specific DC voltage corresponding to the intermediate-frequency signal level. This voltage is then delivered to A/D converter 92 before being converted into binary-coded signals that can be processed by control means 9.

When the aimed frequency is generated, control means 9 delivers control signal to A/D converter 92 so that analogue

signal can be converted into digitally encoded signal. Since the circuit shown in FIG. 18 detects the signal level when the aimed frequency is reached by controlling A/D converter 92, circuit reflecting this embodiment features simplified constitution compared to the mechanism for switching sampling filter.

FIG. 19 is the schematic block diagram of intermediate-frequency signal-level detection means 8 used for realizing the frequency-relationship explained in the preceding FIGS 12, 14, 15 and 17. Sampling filter 93 is comprised of a plurality of frequency-fixed type filters 95 compatible with the aimed frequencies connected to each other in parallel, which sequentially filter out the aimed frequencies. Filtered frequencies are delivered to detector 94, which are then converted into a specific DC voltage corresponding to the needed signal level. Said DC voltage is then delivered to A/D converter 92 before being converted into binary-coded signals that can be processed by control means 9.

When the aimed frequencies are reached, control means 9 feeds control signal to A/D converter 92 for executing analogue-digital conversion of signals. Since the circuit shown in FIG. 19 detects signal level when the aimed

frequencies are reached by controlling A/D converter without switching sampling filter, the circuit featuring simple constitution can easily be made.

FIG. 20 is the schematic block diagram of the circuit of intermediate-frequency signal-level detection means 8 used for realizing the frequency-relationship explained in conjunction with FIGs 13 and 16. Sampling filter 93 is comprised of frequency-fixed type filter 96 that samples signal of the fixed frequencies. Filtered frequencies are then delivered to detector 94, which then converts these frequencies into a specific DC voltage corresponding to the needed signal level. Said DC voltage is then delivered to A/D converter 92 and then converted into binary-coded signal that can be processed by control means 9. When reference-signal frequency reaches the aimed frequency number, control means 9 delivers control signal to A/D converter 92 for executing analogue-digital conversion of signals. Since the circuit shown in FIG. 20 detects signal level when the aimed frequency number is reached by controlling A/D converter, the circuit featuring simple constitution can easily be made up compared to the mechanism for switching sampling filter. Furthermore, since sampling filter is substantially

comprised of a frequency-fixed type filter, the entire circuit is significantly simplified.

FIG. 21 is the schematic block diagram of the circuit of intermediate-frequency signal-level detection means 8 used for realizing the frequency-relationship explained in conjunction with FIGs 12 through 17. Sampling filter 93 is comprised of a plurality of frequency-variable type filters 97 compatible with the aimed frequencies, which sequentially sample signals containing the aimed frequencies. Filtered sample signals are then delivered to detector 94, which are then converted into a specific DC voltage corresponding to the needed signal level before being delivered to A/D converter which converts the received signal into binary-coded signals that can be processed by control means 9.

When the aimed frequency is reached, control means 9 delivers control signal to A/D converter 92 for executing analogue-digital conversion of signals. Since the circuit shown in FIG. 21 detects signal level when the reference signal is exactly at the aimed frequency by controlling A/D converter, the circuit featuring simple constitution can easily be made up compared to the mechanism for switching sampling filter. Furthermore, since sampling filter 93 is

substantially comprised of a frequency-variable filter, even if intermediate-frequency signal uses either a fixed frequency or swept frequency, exactly identical circuit can be constituted.

FIG. 22 is the schematic block diagram of the circuit of intermediate-frequency signal-level detection means 8 explained in conjunction with FIG. 19. Sampling filter 93 is comprised of a plurality of SAW filters 95, which are respectively provided with characteristic for filtering out only the aimed plural frequencies.

Signal-switching circuit 4 delivers a specific intermediate-frequency signal to intermediate-frequency signal-level detection means 8. This signal is then led to sampling filter 93, which then filters out a specific intermediate-frequency signal corresponding to the aimed plural frequencies of reference signal. filtered signal is then delivered to detector 94, in which intermediate-frequency signal rectified by diodes 100 and 101 is converted into a specific DC voltage by capacitor 102 and resistor 98. The DC-converted signal is then converted into binary-coded signal corresponding to said DC voltage by A/D converter 92 before eventually being delivered to control means

9. The aimed frequency is internally detected by said control means 9 which feeds a specific tuning voltage to sweep-signal generating means 2 that generates reference signal. When the aimed frequency is reached, control means 9 feeds control signal to A/D converter 92, which then receives a specific DC voltage corresponding to intermediate-frequency signal level for converting it into binary-coded signals. The circuit shown in FIG. 22 detects signal level when the aimed frequency is reached by controlling A/D converter without switching sampling filter, thus making it possible for the entire system to make up significantly simplified circuit constitution.

FIG. 23 is the schematic block diagram of the circuit of intermediate-frequency signal-level detection means 8 explained in conjunction with the circuit shown in FIG. 20. Sampling filter 93 is comprised of a SAW filter 96 which is provided with characteristic for filtering out the stationary frequency of intermediate-frequency band. Signal-switching circuit 4 delivers a specific intermediate-frequency signal containing a stationary frequency to sampling filter 93 of intermediate-frequency signal-level detection means 8. Sampling filter 93 filters out all the

intermediate-frequency signals compatible with the reference signal containing the aimed plural frequencies. Filtered signal is then delivered to detector 94, where intermediate-frequency signal rectified by diodes 100 and 101 is converted in DC voltage by capacitor 102 and resistor 98. The DC-converted signal is further converted into binary-coded signal corresponding to DC voltage by means of A/D converter 92 before eventually being delivered to control means 9. The aimed frequency is internally detected by said control means 9 which feeds tuning signal to sweep-signal generating means 2 generating the reference signal. When the aimed frequency is reached, control means 9 delivers control signal to A/D converter 92, which then converts the received DC voltage matching intermediate-frequency signal level into binary-coded signal. Since the circuit shown in FIG. 23 uses a sampling filter and detects a specific signal level when the aimed frequency is reached by controlling A/D converter, the entire circuit constitution can be simplified significantly.

FIG. 24 is the schematic block diagram of the circuit of intermediate-frequency signal-level detection means 8 explained in conjunction with the circuit shown in FIG. 21.

Sampling filter 93 is comprised of frequency-variable filter 97 which makes up the tuning circuit using coil 104 and varactor diode 105 used for tuning operation. Said frequency-variable filter 97 feeds a specific tuning voltage to cathode of varactor diode 105 before filtering out signals containing the aimed frequency. Filtered signal is then delivered to detector 94, where intermediate-frequency signal rectified by diodes 100 and 101 is converted into DC voltage by capacitor 102 and resistor 98. The DC-converted signal is further converted into binary-coded signal corresponding to DC voltage by means of A/D converter 92 before eventually being delivered to control means 9. The aimed frequency of the reference signal is internally detected by said control means 9 which feeds tuning signal to sweep-signal generating means 2 generating the reference signal. When the aimed frequency is reached, control means 9 delivers control signal to A/D converter 92, which then converts the received DC voltage matching intermediate-frequency signal level into binary-coded signal. Since the circuit shown in FIG. 24 detects signal level when the reference signal gains access to the aimed frequency by controlling A/D converter 92, the entire circuit can be significantly

simplified compared to the mechanism for switching sampling filter itself. In addition, since sampling filter 93 is substantially frequency-variable filter 97, even if the intermediate-frequency signal uses either a stationary frequency or the swept frequency, the circuit itself can be made up using the identical constitution.

FIG. 25 is the schematic block diagram of the circuit of intermediate-frequency signal-level detection means 8 used for realizing the frequency-relationship explained in the preceding FIGs 12 through 17. A/D converter 107 first converts intermediate-frequency signal output from signal-switching circuit 4 into binary-coded signals. Digital filter 108 samples only a specific frequency of intermediate frequency band corresponding to the aimed frequency of the reference signal for delivery to control means 9. The circuit shown in FIG. 25 uses digital filter for sampling signals containing the aimed frequency, and thus, it is possible for the entire circuit system to introduce semiconductors, and in addition, the aimed frequency can be changed without modifying the circuit constitution.

FIG. 26 is the schematic block diagram of the circuit of intermediate-frequency signal-level detection means 8

used for realizing the frequency-relationship explained in the preceding FIGs 12 through 17. When signal-switching circuit 4 outputs intermediate-frequency signal, CCD filter 109 first receives control signal from control means 9 and then samples a specific frequency from intermediate-frequency band corresponding to the aimed frequency of the reference signal. When A/D converter 107 identifies that the aimed frequency is reached, it receives control signal from control means 9 and converts the sampled signal into binary-coded signal for delivery to control means 9. The circuit shown in FIG. 26 uses CCD filter for sampling the aimed-frequency signal, and thus, it is possible for the system to introduce semiconductors, and in addition, the aimed frequency can be changed without modifying the circuit constitution.

FIGs 27 and 28 are respectively the schematic block diagrams of the circuits of tuning-voltage delivery means of the signal receiver reflecting other preferred embodiments of the present invention.

See FIG. 27. Tuning-voltage delivery means functions as follows. First, control means 9 delivers control signal that causes register 112 to remain in the hold condition and

the binary-coded signal related to tuning voltage. The control signal causes register 112 to hold said binary-coded signal related to tuning voltage. When this signal is delivered to D/A converter 111 while register 112 is still in the hold condition, the system generates a specific tuning voltage that correctly matches the binary-coded signals in order that the tuning voltage can be delivered to base electrode of transistor 114 and then to the tuning circuit via resistor 116 by causing transistor 114 to function as emitter follower. A circuit 117 which is comprised of register 112, D/A converter 111, and transistor 114, is connected to each tuning circuit. Each circuit causes register 112 to hold binary-coded signals related to tuning voltage in order that these signals can effectively be activated for individually supplying tuning voltages. The reference numeral 110 shown in FIG. 27 denotes the power-supply terminal, whereas the reference numerals 113 and 115 respectively denote bias resistors. The circuit shown in FIG. 27 is provided with a register for each tuning circuit, and as a result, once the binary-coded signal is held by register 112, tuning voltage remains constant until changing it in the following process.

The circuit constitution shown in FIG. 27 is ideally suited for fully introducing semiconductor means.

Next, operations of the circuit of tuning-voltage delivery means shown in FIG. 28 are described below. Control means 9 first delivers the control signal turning transistor 120 ON and OFF and the binary-coded tuning voltage to register 112, while causing register 112 to hold the binary-coded tuning voltage data. When this data is delivered to D/A converter 111 while said hold-condition is present, tuning voltage that matches the binary-coded signal is generated, which is then delivered to base electrode of transistor 114. This causes emitter electrodes of transistors 114 and 120 to be connected to each other and capacitor 119 to be also connected between collector electrode and ground of transistor 120. Capacitor 119 is charged while transistor 120 is ON, while it retains the charged voltage while transistor 120 is OFF. As a result, this voltage is supplied to the tuning circuit via resistor 116 as the tuning voltage. A circuit 118 comprised of transistor 120 and capacitor 119 is connected to each tuning circuit. The binary-coded tuning-voltage data is then delivered to register 112, which is then converted into a specific DC voltage by D/A converter

111, and then said DC voltage charges capacitor 119 by provisionally activating transistor 120 of circuit 118 connected to the tuning circuit which needs a specific tuning voltage corresponding to the DC voltage converted by D/A converter 111. After a specific tuning voltage is delivered to respective tuning circuits, the tuning voltage is again delivered to respective tuning circuits based on the discharge constant shorter than that of capacitor 119 so that tuning voltage can be prevented from incurring variation. The reference numerals 113, 115 and 121 respectively denote bias resistors. The circuit shown in FIG. 28 allows a specific tuning voltage to be sequentially supplied to respective tuning circuits. As a result, once the tuning voltage is securely held by register means, variation of tuning voltage remains minimum until the tuning voltage is changed next. In addition, since the circuit shown in FIG. 28 uses each one unit of register and D/A converter which respectively need a number of component elements, and yet, since each tuning circuit uses each one unit of transistor and capacitor to make up extremely simplified constitution, the circuit constitution shown in FIG. 28 is ideally suited for fully introducing semiconductor means.

FIGs 29 and 30 are respectively the schematic block diagram of the signal-switching circuit 3 of the signal receiver, denoting preferred embodiments of the present invention. In the circuit diagram shown in FIG. 29, the desired-channel signal is received from input terminal 11, which is then delivered to anode of diode 124 via DC-blocking capacitor 123. On the other hand, the reference signal from sweep-signal generating means 2 is delivered to anode of diode 122 via DC-blocking capacitor 131. Bias current is delivered to diode 124 via resistor 132 and choke-coils 126 and 127. Resistor 128 is connected to the connection point of choke coil 127 and resistor 132 and to base electrode of transistor 129. Collector electrode of transistor 129 is connected to anode of diode 122 via choke coil 130. Cathodes of diodes 122 and 124 are respectively connected to each other, while choke coil 126 is connected between the contact point of both cathodes and ground. Said contact point is also connected to R-circuit 1 via DC-blocking capacitor 125. Thus, when control means 9 feeds control voltage that turns transistor OFF, diode 124 becomes connective and diode 122 disconnected, allowing the desired-channel signal from terminal 11 to be fed to R-circuit 1.

Conversely, when control means 9 delivers control signal that activates transistor 129, diode 122 becomes connective and diode 124 disconnected, thus allowing sweep-signal generating means 2 to deliver reference signal to R-circuit 1 to implement switching of signals. The system shown in FIG. 29 features simplified circuit constitution that effectively switches signals using only two units of diodes.

Next, operations of the circuit shown in FIG. 30 are described below. The desired-channel signal is received from terminal 11, which is then delivered to base electrode of transistor 138 via DC-blocking capacitor 123. On the other hand, sweep-signal generating means 2 delivers reference signal to base electrode of transistor 137 via DC-blocking capacitor 131. Emitter electrodes of transistors 137 and 138 are connected to each other, while the connected point of these electrodes remains in contact with collector electrode of transistor 141. Constant bias current is delivered to transistor 141 via constant-voltage-regulated power-supply source 143 and bias resistors 142 and 143, thus making up a constant-current circuit. On the other hand, control means 9 feeds control signal to base electrode of transistor 137 via resistor 139. Control signal from

control means 9 is also fed to base electrode of transistor 133 via resistor 140, while collector electrode of transistor 133 is connected to base electrode of transistor 138. Collector electrode of said transistor 133 is also connected to power-supply source via resistor 134. collector electrode of transistor 141 is connected to R-circuit 1 via DC-blocking capacitor 125. Consequently, when control means 9 delivers control voltage to turn transistor 133 OFF, collector potential of said transistor 133 rises to turn transistor 138 ON and transistor 137 OFF, thus allowing the desired-channel signal from terminal 11 to be delivered to R-circuit 1. Conversely, when control means 9 delivers control voltage that activated transistor 129, transistor 138 turns OFF and transistor 137 ON, thus allowing the reference signal from sweep-signal generating means 2 to be delivered to signal R-circuit 1 so that signal switching can be implemented. Since the circuit system shown in FIG. 30 merely uses transistors and resistors to make up the entire constitution, this system is ideally suited for fully introducing semiconductor means to make up an integrated circuit.

FIGs 31 and 32 are respectively the schematic block diagrams of the signal-switching circuit of the signal

receiver, reflecting preferred embodiments of the present invention. See FIG. 31. Intermediate-frequency signals from R-circuit 1 are first delivered to cathode of diode 122 via DC-blocking capacitor 125. Anode of diode 124 is connected to intermediate-frequency amplifier/demodulator 6 via DC-blocking capacitor 123, whereas anode of diode 122 is connected to intermediate-frequency signal-level detection means 8 via DC-blocking capacitor 131. Diode 124 receives bias current from resistor 132 and choke-coils 126 and 127. Resistor 128 is connected to the connection point between choke-coil 127 and resistor 132 and also to base electrode of transistor 129. Collector electrode of transistor 129 is connected to anode of diode 122 via choke coil 130. Cathodes of diodes 122 and 124 are connected to each other, while choke coil 126 is connected to the connection point of these cathodes and between grounds. Consequently, when control means 9 delivers control signal that turns transistor 129 OFF, diode 124 becomes connective and diode 122 disconnected, thus allowing intermediate-frequency signal from R-circuit 1 to be delivered to intermediate-frequency amplifier/demodulator 6 via DC-blocking capacitor 123. conversely, when control means 9 delivers control signal that

activates transistor 129, diode 122 becomes connective and diode 124 disconnected. This allow intermediate-frequency signal from R-circuit 1 to be delivered to intermediate-frequency signal-level detection means 8 via DC-blocking capacitor 131 so that signal switching can be implemented. The circuit system shown in FIG. 31 executes switching of signals by applying only two units of diodes, thus featuring extremely simplified constitution.

See FIG. 32. Intermediate-frequency signal from receiver 1 is first delivered to base electrode of transistor 141 via DC-blocking capacitor 145. Collector electrode of transistor 138 is connected to intermediate-frequency amplifier/demodulator 6 via DC-blocking capacitor 146. On the other hand, collector electrode of transistor 137 is connected to intermediate-frequency signal-level detection means 8 via DC-blocking capacitor 147. Emitter electrodes of said transistors 137 and 138 are connected to each other. The connection point of these emitter electrodes is connected to collector electrode of transistor 141 which receives constant bias current from constant-voltage-regulated power-supply source 143 and bias resistor 144, thus making up a constant-current circuit. On the other hand, control means

9 delivers control signal to base electrode of transistor 137 via resistor 139, while control signal from control means 9 is also delivered to base electrode of transistor 133 via resistor 140. Collector electrode of transistor 133 is connected to base electrode of transistor 138. Collector electrode of transistor 133 is connected to power-supply source via resistor 134. On the other hand, collector electrode of transistor 141 is connected to R-circuit 1 via DC-blocking capacitor 125. Consequently, when control means 9 outputs control voltage that turns transistor 133 OFF, collector potential rises to turn transistor 138 ON and transistor 137 OFF, thus allowing intermediate-frequency signal from R-circuit 1 to be delivered to intermediate-frequency amplifier/demodulator 6 via DC-blocking capacitor 146. Conversely, when control means 9 delivers control voltage activating transistor 129, transistor 138 turns OFF and transistor 137 ON to allow intermediate-frequency signal from R-circuit 1 to be delivered to intermediate-frequency signal-level detection means 8 via DC-blocking capacitor 147 so that signal switching operation can eventually be implemented. The circuit system shown in FIG. 32 merely uses transistors and resistors to make up the entire constitution, and

thus, this circuit system is ideally suited for implementing an integrated circuit by fully introducing semiconductor means.

FIGs 33 and 34 are respectively the schematic block diagrams of AGC-voltage hold means of the signal receiver reflecting still further preferred embodiments of the present invention. See FIG. 33. AGC voltage output from intermediate-frequency amplifier/demodulator 6 is first delivered to emitter electrode of transistor 153 which turns ON and OFF on receipt of control signal from control means 9. While receiving the desired-channel signal, transistor 153 remains activated. This transistor however remains OFF until tuning voltages are eventually set after completing delivery of channel-select signal from channel-select means to control means 9. While transistor 153 is ON, capacitor 151 is charged with a specific DC voltage proportional to the AGC voltage. When transistor 153 is OFF, AGC-voltage hold means holds the voltage immediately before transistor 153 turns OFF. Capacitor 151 delivers its voltage to base electrode of transistor 148, while this voltage is also delivered to radio-frequency amplifier 13 and sweep-signal generating means 2 via resistor 149 from emitter electrode

of said transistor 148 acting as the emitter-follower. Consequently, while transistor is ON, AGC voltage which is varied by control signal from control means 9 is delivered to radio-frequency amplifier 13 and sweep-signal generating means 2. When transistor 153 is OFF, AGC-voltage hold means holds a specific AGC voltage which was present immediately before transistor 153 turns OFF. This allows the system to feed constant voltage to radio-frequency amplifier 13 and sweep-signal generating means 2. The circuit system shown in FIG. 33 securely holds a specific AGC voltage using two transistors and a capacitor, thus greatly helps promote simplification of the circuit constitution.

See FIG. 34. A specific AGC voltage output from intermediate-frequency amplifier/demodulator 6 is first converted into binary-coded signal by A/D converter 156, which is then delivered to register 155 to securely maintain the status inside of register 155. Thus, when holding the AGC voltage constant, the content of said register 155 is retained. Data signal output from register 155 is converted into an analogue voltage by D/A converter 154, which is then delivered to radio-frequency amplifier 13 and sweep-signal generating means 2. The circuit system shown in FIG. 34

uses register means that holds the binary-coded AGC voltage data. This circuit effectively prevents the retained AGC-voltage from varying itself due to varying environmental conditions.

FIG. 35 is the simplified block diagram of control means of the signal receiver reflecting preferred embodiments of the present invention. The tuning control procedure for operating the signal receiver related to the present invention is converted into binary-coded data, which is stored in a non-volatile memory 164. All the system elements function in accordance with these data related to the established tuning control procedure. The binary-coded channel-control signal output from channel-select command means 10 is delivered to data-receiving register (1) 159 through input-buffering gate 157. On the other hand, in accordance with the tuning control procedure, operation circuit 163 first reads the content of data-receiving register (1) 159 and then delivers the binary-coded tuning voltage data signal to signal-output register (2) 162, which then outputs this data signal to local oscillator 16, input tuning circuit 12 and interstage tuning circuit 14 via output-buffer gate 158. The tuning voltage data delivered to these circuits is stored in

volatile memory 165. Next, control means delivers binary-coded control signal to signal-output register (1) 161. This controls AGC-voltage hold means 5 for retaining AGC voltage constant. Control means then delivers binary-coded control signal to signal-output register (1) 161 for switching signal-switching circuits 3 and 4. Then, control means delivers tuning voltage to signal-output register (2) 162 for delivery to sweep-signal generating means 2. Control means also delivers control signal to signal-output register (1) 161 for controlling sweep-signal generating means 2. These signals from control means are respectively delivered to sweep-signal generating means 2 via output-buffer gate 158. Selection of respective tuning circuits, delivery and fine variation of the tuning voltage are executed in the same manner as described above.

Next, intermediate-frequency signal output from R-circuit 1 is converted into binary-coded signals by intermediate-frequency signal-level detection means 8 before being delivered to signal-input register (2) 160 via input-buffer gate 157. Operation circuit 163 then compares the binary-coded intermediate-frequency signal to the aimed frequency characteristics and then varies the tuning voltage so that

the best frequency characteristics can be generated by executing sequential operations identical to those which are described above. When the optimum frequency characteristics are achieved, control means causes non-volatile memory 164 to store the data related to the tuning voltage delivered to respective tuning circuits. Control means then sets signal-switching circuits 3 and 4 and AGC-voltage hold means 5 to the status of correctly receiving the desired-channel signal.

The circuit system shown in FIG. 35 easily varies the tuning control procedure merely by changing the content of non-volatile memory. The circuit system shown here is ideally suited for making up an integrated circuit by fully introducing semiconductor means.

FIG. 36 is the simplified block diagram of the entire circuit of the signal receiver, denoting the third preferred embodiment of the present invention. Terminal 116 receives those signals which are in a specific frequency band different from those channel band delivered to terminal 11. Signal-switching circuits 3 and 167, input-tuning circuits 12 and 168, radio-frequency amplifiers 13 and 169, interstage tuning circuits 14 and 170, and mixers 15 and 171, are

respectively provided with identical constitution. Using signals oscillated by local oscillator 16, the desired-channel signal from terminal 11 is converted into intermediate-frequency signal by mixer 15. Likewise, using signals oscillated by the oscillator of sweep-signal generating means 2, the desired-channel signal from terminal 116 is converted into intermediate-frequency signal by mixer 171.

Consequently, when receiving the desired-channel signal from terminal 11, local oscillator 16 is made available for selecting the desired channel. Conversely, when receiving the desired-channel signal from terminal 116, oscillator of sweep-signal generating means 2 is used so that it functions as the local oscillator itself, whereas local oscillator 16 itself is made available for the oscillator of sweep-signal generating means 2. The circuit constitution denoting the third preferred embodiment of the present invention shown in FIG. 36 eliminates the needs for providing an additional oscillator generating reference signal needed for controlling the tuning voltage of the receiver unit receiving signal of a plurality of frequency bands. In addition, since a local oscillator which is not used for channel-selection is made available, compared to the circuit of the second

preferred embodiment, the circuit constitution shown in FIG. 36 can be significantly simplified.

The present invention being thus described. However, it is obvious that the same way may be varied in many ways by those skilled in the art. It should be understood, however, that such variations are not to be regarded as a departure from the spirit and scope of the present invention, but all such modifications are intended to be included within the scope of the following claims.

CLAIMS:

1. A signal receiver comprising;
oscillator means (16) provided for receiver part
(1) which receives signals by applying frequency-conver-
sion means;
5 sweep-signal generating means (2) generating
reference signal which sweeps frequencies of desired-
channel band before delivering said reference signal to
first signal switching circuit (3);
AGC-voltage hold means (5) that retains AGC
10 voltage before delivery to said receiver part;
tuning-voltage delivery means (7) supplying
individual tuning voltages to respective tuning circuits
(14), said sweep-signal generating means (2) and local
oscillator means (16) of said receiver part;
15 intermediate-frequency signal-level detection
means (8) detecting signal intensity in conjunction
with plural frequencies of intermediate-frequency signals
output from said receiver part;
control means (9) that converts respective
20 tuning voltages and intermediate-frequency signal-level
into binary-coded signals before storing these data in
memory, followed by processing of memory content, and
control of said signal-switching circuit, said
intermediate-frequency signal-level detection means,
25 and said AGC-voltage hold means;
operation procedure comprising the sequential
steps of;
after selecting desired channel, said receiver
part receives signals of desired channel frequency band
30 through said first signal-switching circuit;
immediately after said AGC-voltage hold means
holds AGC-voltage, said desired-channel signal is
switched to said reference signal by said first signal-
switching circuit before delivering said reference signal
35 to said receiver part;

0208470

intermediate-frequency signal from said receiver
part is then delivered to said intermediate-frequency
signal-level detection means from the following
intermediate-frequency amplifier/demodulator through
5 second signal-switching circuit;
detection of signal levels covering plural
frequencies and detection of frequency characteristic of
signals received by and delivered from said receiver part;
comparison of detected frequency character-
10 istics to aimed frequency characteristics using said
control means;
sequentially determining tuning voltages of
respective tuning circuits for minimizing error of said
comparison results and delivering these tuning voltages
15 to respective circuits through said tuning-voltage
delivery means;
switching of said reference signal to said
desired-channel signal by means of first signal-switching
circuit; and
20 delivering intermediate-frequency signal to said
intermediate-frequency amplifier/demodulator means
through second signal-switching circuit so that signal
receiver unit can securely receive desired-channel signal.

25 2. The signal receiver defined in claim 1, in which
said sweep-signal generating means is comprised of
oscillator means and either (a) signal-level control
circuit and delivers oscillated signal level to said first
signal-switching circuit after varying said oscillated
30 signal level, or (b) signal-level-control type mixer means,
while said sweep-signal generating means generates summed
and differential frequencies by causing said signal-level-
control type mixer means to mix signals oscillated by
local oscillator means of receiver part together with
35 signals oscillated by (primary) oscillator means and then

controls levels of these signals before delivering these signals to first signal-switching circuit.

3. The signal receiver defined in claim 1, in which
5 signals of intermediate-frequency band generated by feeding oscillated signal from said sweep-signal generating means to said receiver part are substantially either frequency-swept signals or signals containing stationary frequencies.

10 4. The signal receiver defined in claim 3, in which either (a) oscillated signals from primary oscillator means comprises sweep frequencies whereas oscillated signals from local oscillator means are substantially
15 signals containing stationary frequencies, or (b) oscillated signals from primary oscillator means and local oscillator means of said receiver part respectively comprise sweep frequencies using the identical sweeping velocity, band-width, and in the identical sweeping
20 direction, or (c) oscillated signal from primary oscillator means contain stationary frequencies, whereas signal oscillated by local oscillator means of said receiver part contains swept frequencies.

25 5. The signal receiver defined in claim 4, in which signal oscillated by primary oscillator means is substantially within either (a) the desired-channel frequency band of said receiver part, (b) the intermediate-frequency band of said receiver part, or (c) bands corresponding to
30 the sum of frequencies oscillated by local oscillator means of said receiver part and the desired-channel frequency.

35 6. The signal receiver defined in claim 2, in which signal-level control circuit is comprised of first and second diodes and cathode terminal of said first diode

0208470

receives oscillated signal from primary oscillator means, where anode terminals of said first and second diodes are connected to each other so that said oscillated signal can be output from cathode of said second diode, while cathode terminals of said first and second diodes are respectively grounded via resistors, thus allowing the level control system to feed AGC voltage to the connected point of anode terminals of said first and second diodes via resistor means so that a specific signal-level-data signal matching said AGC voltage can securely be output from said control circuit.

7. The signal receiver defined in claim 2, in which signal-level circuit is comprised of; cathode electrodes of first and second transistors being connected to each other, base electrode of first transistor being connected to emitter electrode of second transistor via DC-blocking capacitor; where base electrode of first transistor receives oscillated signal from oscillator means to output said signal from collector electrode of first transistor, and at the same time, AGC-voltage hold means delivers AGC-voltage to base electrode of second transistor to allow signal gain to vary itself by varying collector voltage of first transistor in response to said AGC voltage.

8. The signal receiver defined in claim 2, in which signal-level-control type mixer means is comprised of elements and functions including; emitter electrodes of third and fourth transistors and collector electrode of fifth transistor that are connected to each other, where emitter electrode of fifth transistor grounds high-frequency components and is connected to emitter electrode of sixth transistor via DC-current while grounding collector electrode of said sixth transistor, base

electrode of either third or fourth transistor which receives oscillated signal from oscillator means and is connected to collector electrode of fourth transistor in order that mixed signal can be output from it, base
5 electrode of said sixth transistor which receives AGC voltage from AGC-voltage hold means so that DC voltage corresponding to AGC voltage can be generated in fifth transistor to cause conversion gain of said sixth transistor to vary to subsequently vary output level of
10 mixed signal before eventually feeding said mixed signal to signal-switching circuit.

9. The signal receiver defined in claim 2, in which said signal-level-control type mixer means is further
15 comprised of elements and functions including; emitter electrodes of seventh and eighth transistors and collector electrode of ninth transistor which are connected to each other, collector electrodes of seventh and eighth transistors which are respectively connected to collector
20 electrode and emitter electrode of tenth transistor in order that oscillated signal from primary oscillator means can be delivered to base electrode of seventh or eighth transistor and also oscillated signal from local oscillator means of receiver part can be delivered to base electrode
25 of ninth transistor, while allowing AGC-voltage hold means to deliver AGC voltage to base electrode of tenth transistor to cause conversion gain of said mixer means to vary by varying collector voltages of seventh and eighth transistors in response to AGC voltage to subsequently
30 vary output level of mixed signal before eventually feeding said mixed signal to signal-switching circuit.

10. The signal receiver defined in claim 2, in which said signal-level-control type mixer means is further
35 comprised of elements and functions including; emitter

electrodes of eleventh and twelfth transistors and collector electrode of thirteenth transistor being connected to each other, collector electrodes of said eleventh and twelfth transistors that are respectively
5 connected to anode and cathode of third diode with respect to radio-frequency components, while base electrode of either eleventh or twelfth transistor receives oscillated signal from primary oscillator means and base electrode of
10 thirteenth transistor receives oscillated signal from local oscillator means of receiver part, and said anode of third diode receives AGC voltage from AGC-voltage hold means in order to vary conversion gain of mixer means by varying collector voltage of said eleventh and twelfth
15 transistors to subsequently vary output level of mixed signal before eventually feeding said mixed signal to signal-switching circuit.

11. The signal receiver defined in claim 1, in which intermediate-frequency signal-level detection means first
20 causes either (a) needed signal to be converted into DC voltage by applying sampling filter and detector means and then converts said DC voltage into binary-coded data signal matching said DC voltage by applying A/D converter means, (b) signals of intermediate-frequency band to be converted
25 into binary-coded data signal by applying A/D converter means and then activated digital filter to sample only the needed signal, or (c) CCD filter to sample only the needed signal of intermediate-frequency band and then causes the sampled signal to be converted into binary-coded
30 data signal by applying A/D converter means.

12. The signal receiver defined in claim 1, in which tuning-voltage delivery means holds binary-coded signal fed from control means in register means, and then, after
35 feeding said signal to D/A converter means, causes said

binary-coded signal to be converted into DC voltage, where said tuning-voltage delivery means is provided with a plurality of conversion parts being connected to each other in parallel by the number of tuning circuits in order that DC voltage can be delivered to one of said tuning
5 circuits before eventually establishing a specific tuning voltage for delivery to respective tuning circuits by writing binary-coded data signal into said register means provided for said conversion parts corresponding to
10 respective tuning circuits.

13. The signal receiver defined in claim 1, in which said tuning-voltage delivery means is further comprised of elements and functions including; first register means that
15 holds binary-coded data signal fed from control means until it delivers said signal to first D/A converter means, said D/A converter means then outputs the analogue-converted signal to base electrode of fourteenth transistor so that said signal can be output from emitter electrode of four-
20 teenth transistor functioning as emitter follower, while emitter electrodes of fourteenth and fifteenth transistors are connected to each other and base electrode of fifteenth transistor receives control signal from control means, whereas collector electrode of fifteenth transistor is
25 connected to first capacitor between grounds to cause said first capacitor to hold tuning voltage delivered to emitter electrode of said fourteenth transistor by control signal before feeding said tuning voltage to tuning circuits which are respectively provided with a tuning
30 voltage hold circuit incorporating fifteenth transistor and first capacitor, while said tuning-voltage hold circuit is connected to adjacent tuning-voltage hold circuits in parallel with each other.

35 14. The signal receiver defined in claim 11, in which said sampling filter is substantially either (a) the

frequency-fixed type filter itself, (b) the frequency-variable filter itself, or (c) one unit of said frequency-fixed type filter is provided.

5 15. The signal receiver defined in claim 14, in which a plurality of said frequency-variable filters are connected to each other in parallel.

10 16. The signal receiver defined in claim 1, in which first signal-switching circuit is comprised of elements and functions including; cathodes of fourth and fifth diodes which are connected to each other, while anode of fourth diode receives desired-channel signal and anode of fifth diode receives reference signal fed from sweep-
15 signal generating means, while anodes of fourth and fifth diodes are connected to each other so that they can respectively receive voltages from base electrode and collector electrode of sixteenth transistor, and conversely, said base electrode of sixteenth transistor receives
20 signal-switching control signal from control means to cause either fourth or fifth diode to be activated so that either of signals flowing through anodes of fourth and fifth diodes can eventually be delivered to cathodes of said diodes.

25 17. The signal receiver defined in claim 1, in which said first signal-switching circuit is further comprised of elements and functions including; emitter electrodes of seventeenth and eighteenth transistors and collector
30 electrode of nineteenth transistor are respectively connected to each other, while base electrodes of seventeenth and eighteenth transistors respectively receive desired-channel signal and reference signal, and in addition, base electrode of seventeenth and eighteenth
35 transistors are connected to each other so that they can

respectively receive voltages from base and collector of twentieth transistor, and conversely, base electrode of twentieth transistor receives signal-switching control signal from control means for activating either seven-
5 teenth or eighteenth transistor so that either of signals flowing through base electrodes of seventeenth and eighteenth transistors can eventually be delivered to collector electrode of nineteenth transistor.

10 18. The signal receiver defined in claim 1, in which second signal-switching circuit is comprised of elements and functions including; cathodes of sixth and seventh diodes being connected to each other, while contact point of both cathodes receives signal from receiver part, and
15 in addition, base and collector of twenty-third transistor are connected to each other so that voltages from these can respectively be delivered to anodes of sixth and seventh diodes, while base electrode of said twenty-
20 third transistor receives signal-switching control signal from control means for activating either sixth or seventh diode so that signals flowing through cathodes of sixth and seventh diodes can be delivered to either of anodes of sixth and seventh diodes before eventually feeding signal
25 from receiver part to either intermediate-frequency amplifier means or intermediate-frequency signal-level detection means.

19. The signal receiver defined in claim 1, in which said second signal-switching circuit is further comprised
30 of elements and functions including; emitter electrodes of twenty-fourth and twenty-fifth transistor and collector electrode of twenty-sixth transistor being connected to each other, while base electrode of twenty-sixth transistor receives signal from receiver part, and in addition, base
35 electrodes of twenty-fourth and twenty-fifth transistors

are connected to each other for respectively receiving voltages from base and collector of twenty-seventh transistor, while base electrode of twenty-sixth transistor receives constant voltage and base electrode of twenty-
5 seventh transistor receives signal-switching control signal from control means for activating either twenty-fourth or twenty-fifth transistor so that signals flowing through base electrodes of twenty-sixth transistor can eventually be delivered to either of collector elec-
10 trodes of twenty-fourth and twenty-fifth transistors.

20. The signal receiver defined in claim 1, in which AGC-voltage hold means is provided with elements and functions including; emitter electrodes of twenty-first
15 transistor first receives AGC voltage and then base electrode of said twenty-first transistor receives control voltage from control means, whereas collector electrode of said twenty-first transistor is connected to base electrode of twenty-second transistor, while second
20 capacitor is connected to contact point of base electrode of twenty-second transistor and collector electrode of twenty-first transistor and between grounds as well so that said second capacitor can be charged with AGC voltage when twenty-first transistor is activated by
25 control voltage, whereas said second capacitor retains AGC voltage while twenty-first transistor is OFF, thus allowing emitter electrode of twenty-second transistor to feed AGC voltage to radio-frequency amplifier means and sweep-signal generating means.

30
21. The signal receiver defined in claim 1, in which said AGC-voltage hold means is further comprised of elements and functions including; first A/D converter means that receives AGC voltage, which is then converted
35 into binary-coded data signal by said A/D converter means,

- 80 -

and after delivery of said signal to register means, said binary-coded data signal is delivered to second D/A converter means for conversion into DC voltage, which is then delivered to radio-frequency amplifier and sweep-
5 signal generating means, and then, control means feeds control signal to said register means to latch binary-coded data signal stored in said register means so that AGC voltage can securely be latched.

10 22. The signal receiver defined in claim 2, in which when receiver part is provided with a plurality of local oscillator means, these local oscillator means are not used for receiving desired-channel signals.

15

FIG. 1

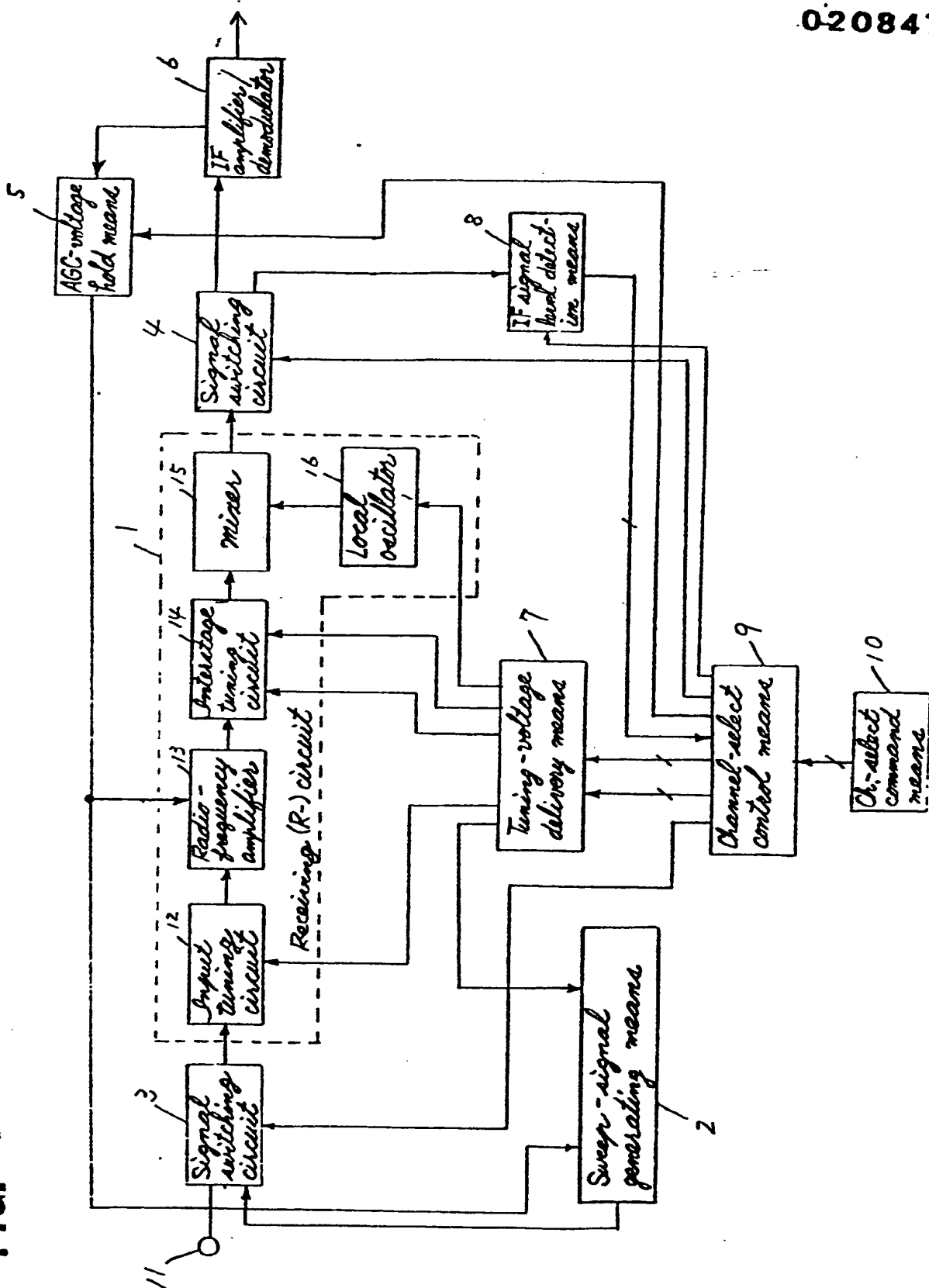


FIG. 2

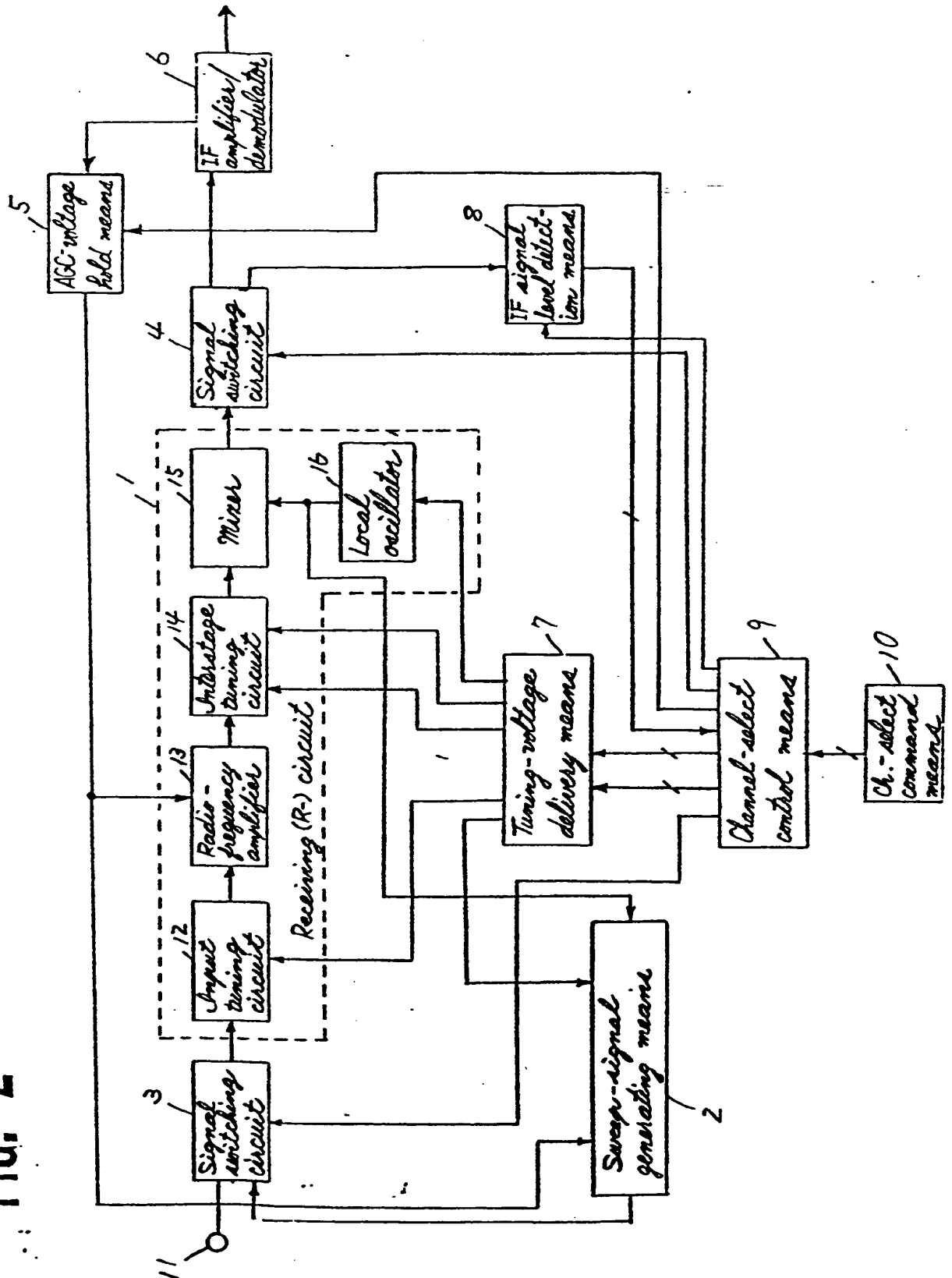


FIG. 3

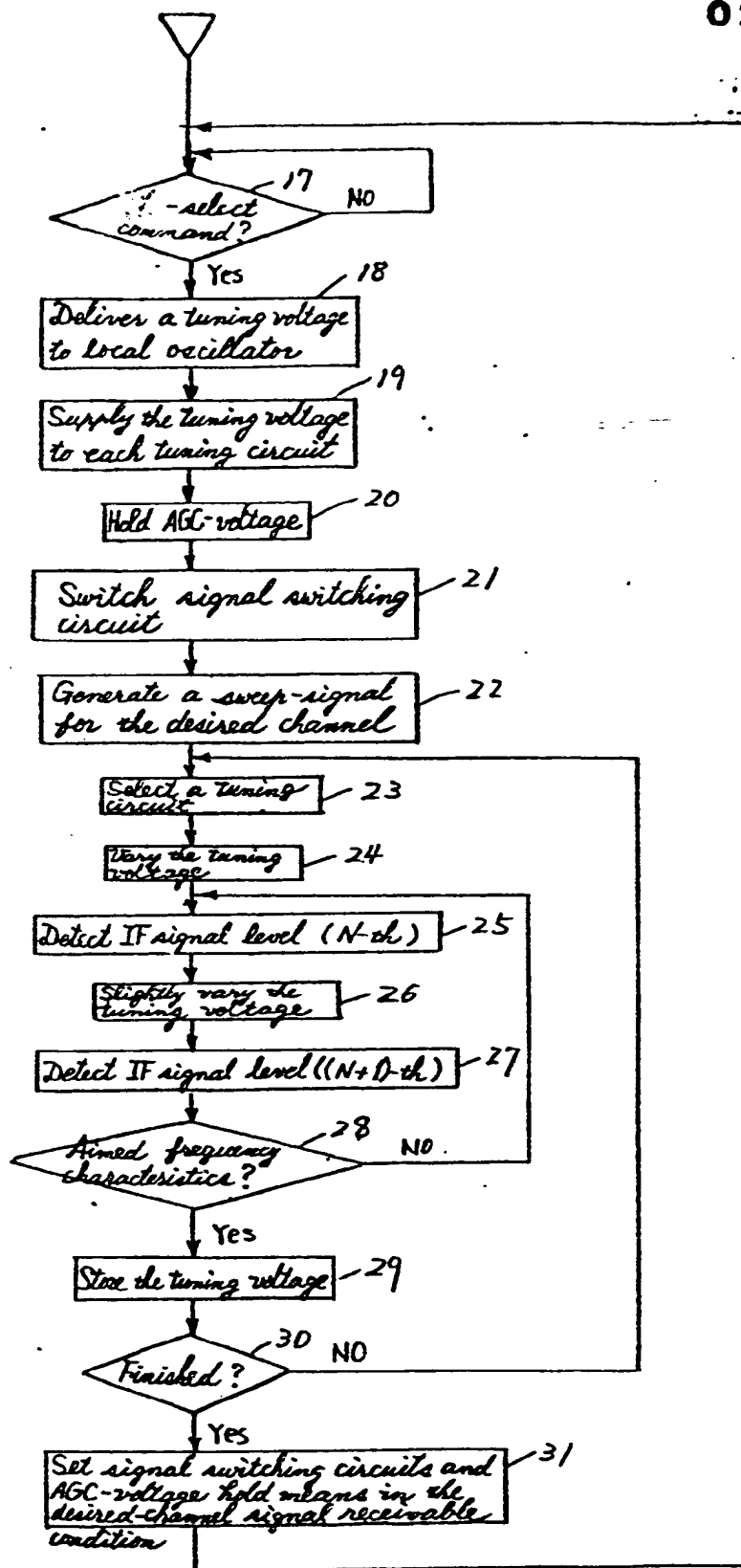


FIG. 4

| Maximum value Flatness comparison | | | N-th | (N+1)-th | N-th | (N+1)-th |
|--------------------------------------|----------|----|----------------------------------|----------|----------------------------------|----------|
| | | | Large | Small | Small | Large |
| ID step 1 | N-th | OK | N-th | | N-th | |
| | | NG | To ID step 2 | | To ID step 2 | |
| ID step 2 | (N+1)-th | OK | N-th | | (N+1)-th | |
| | | NG | Tuning voltage fine variation | | Tuning voltage fine variation | |

FIG. 5

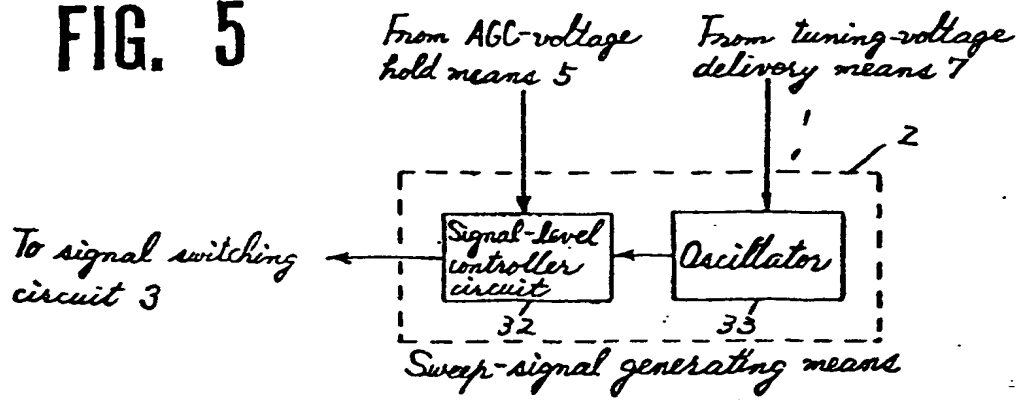
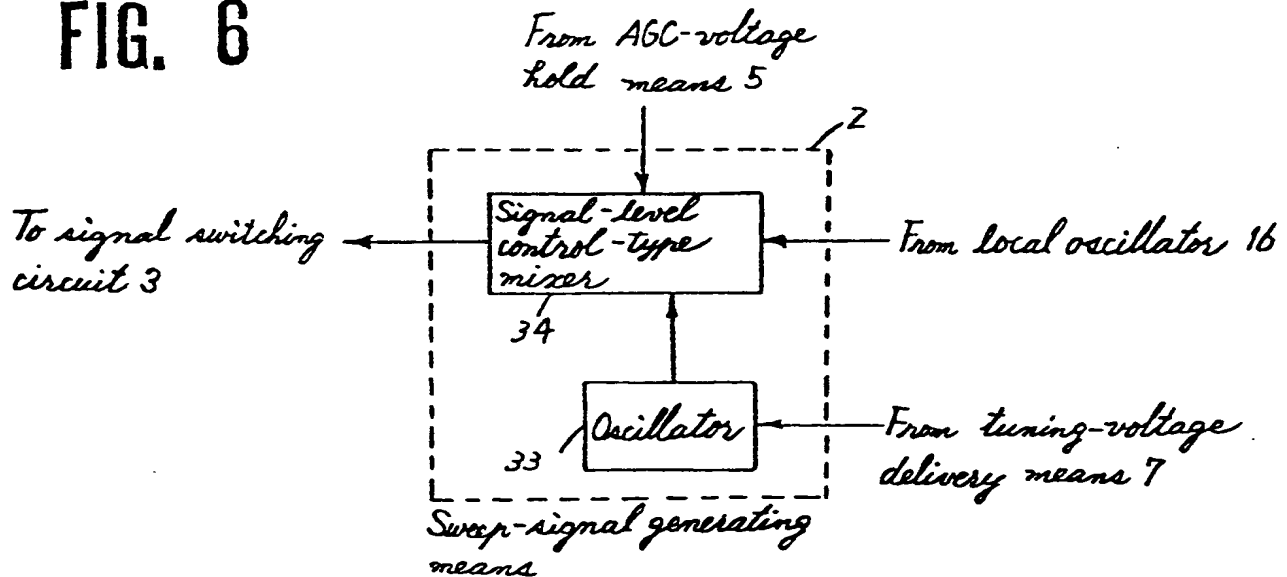


FIG. 6



6/20

FIG. 7

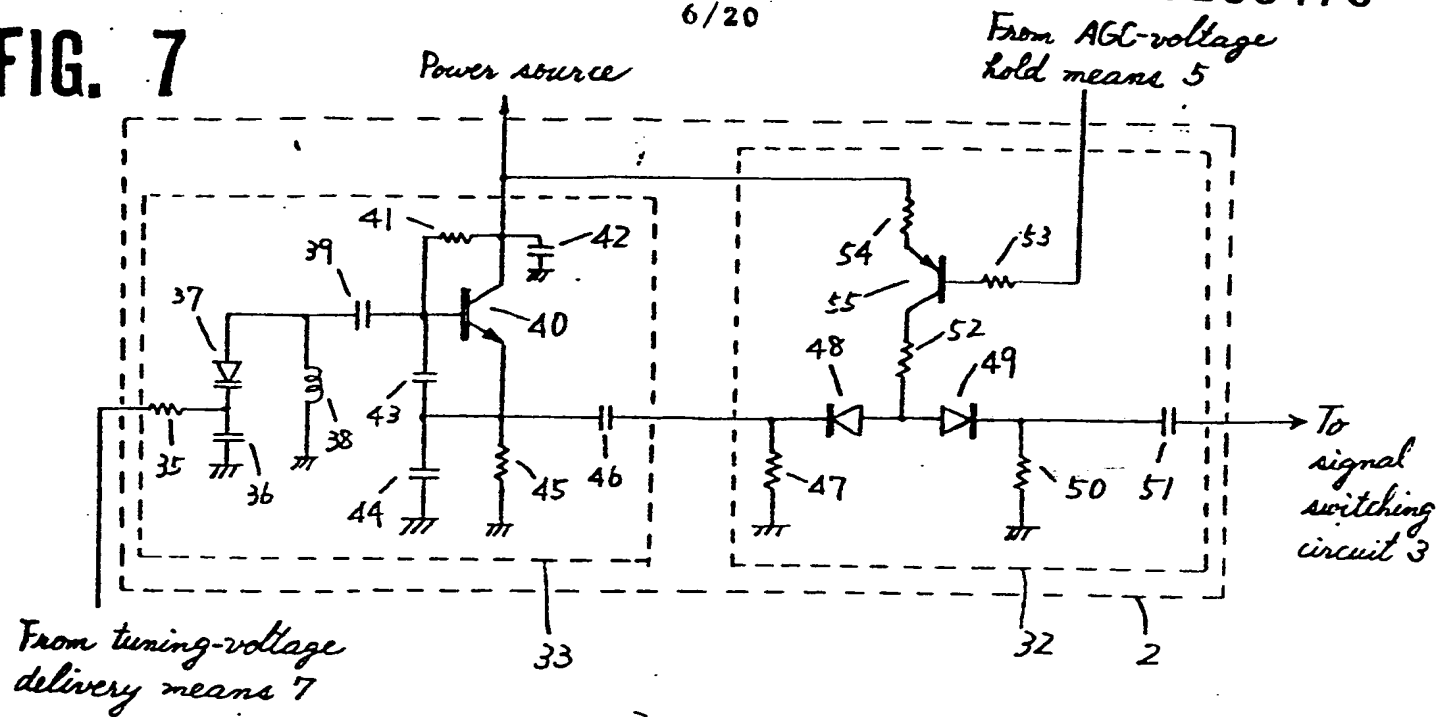


FIG. 8

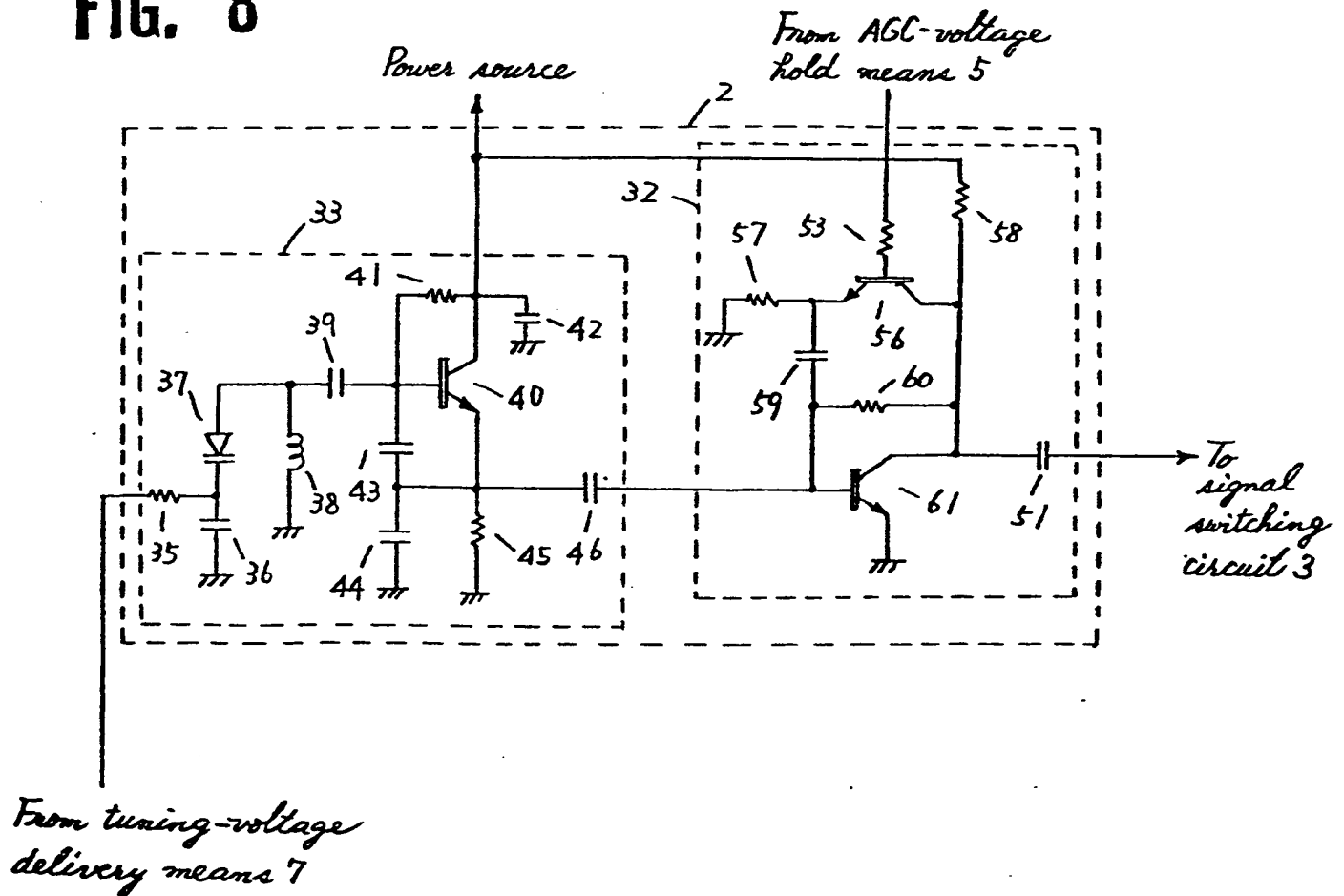
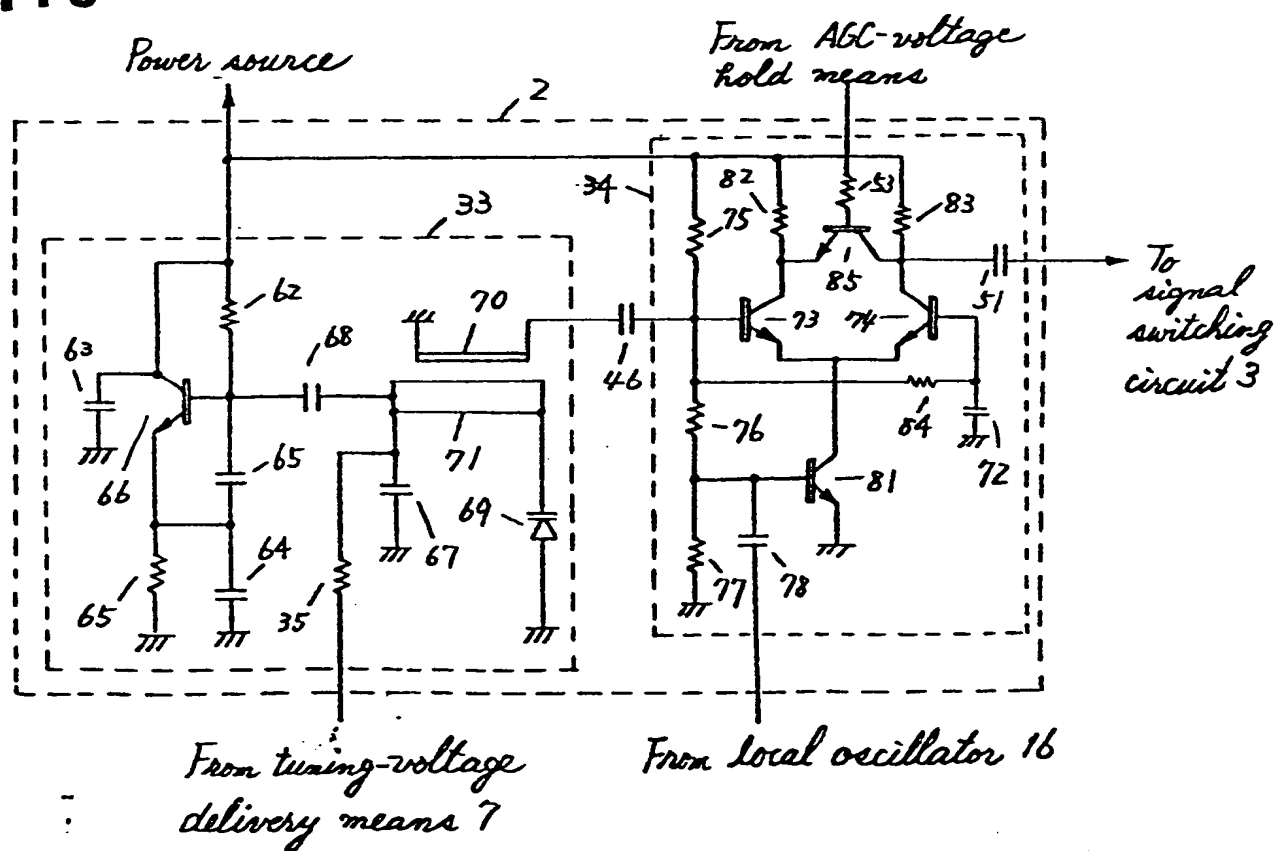


FIG. 9



8/20

0208470

FIG. 11

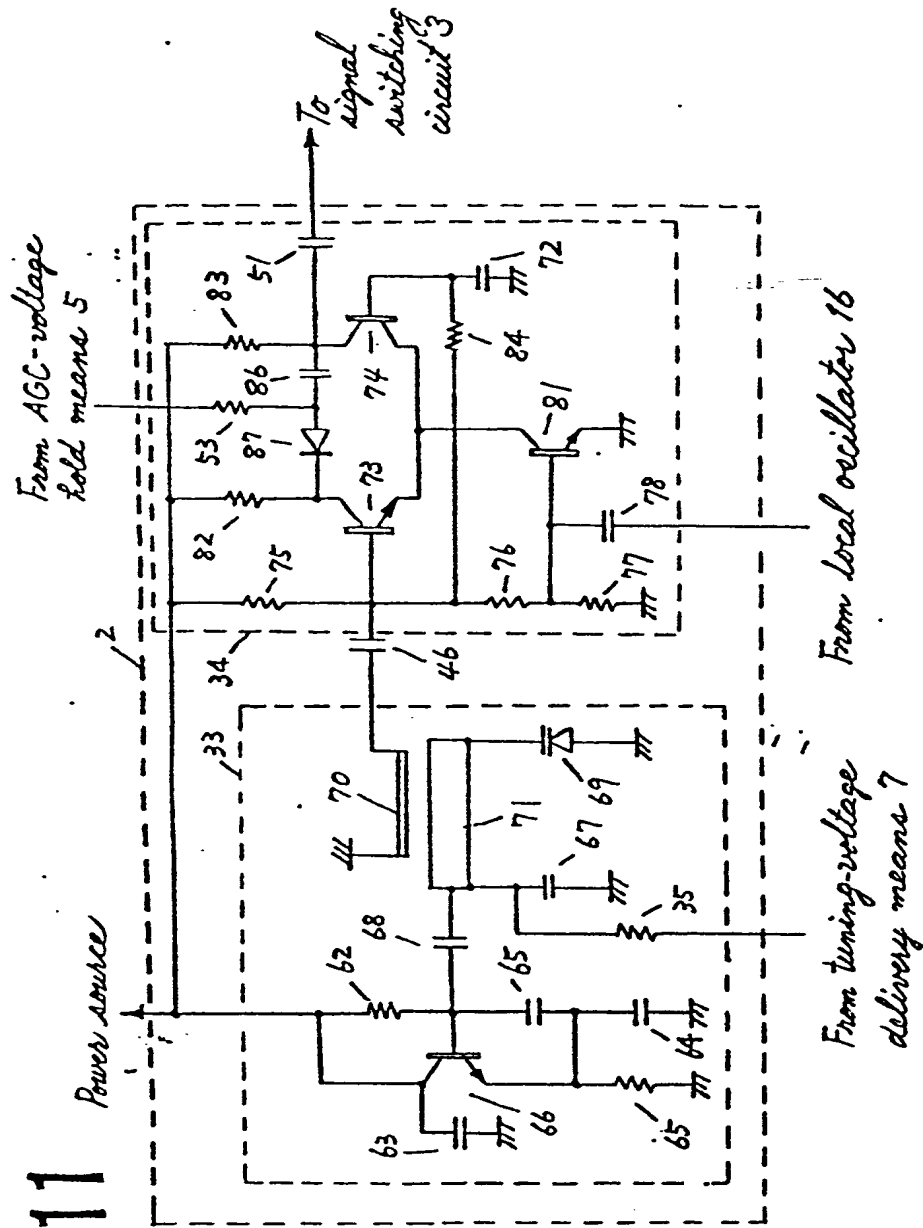
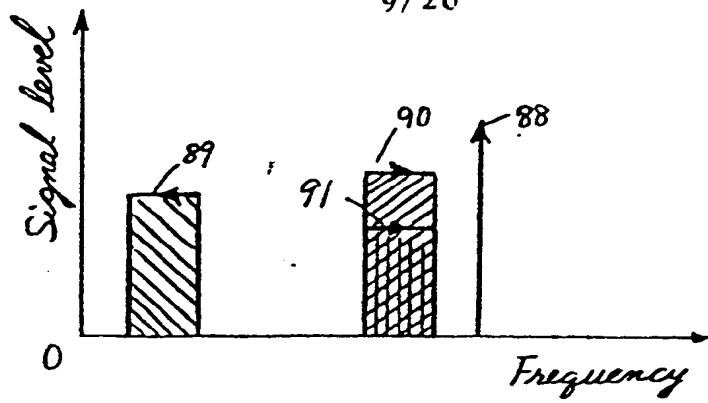


FIG. 12



0208470:

FIG. 13

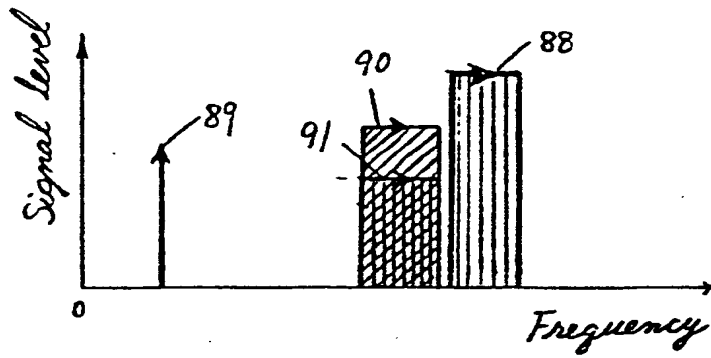


FIG. 14

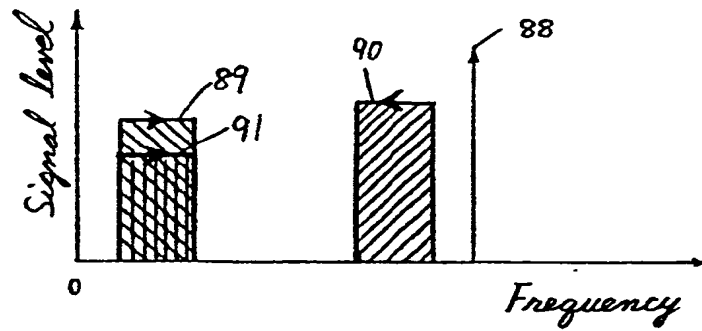


FIG. 15

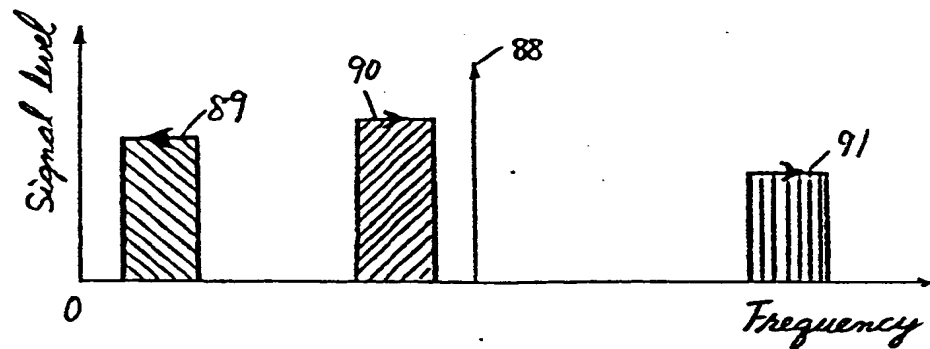


FIG. 16

0208470

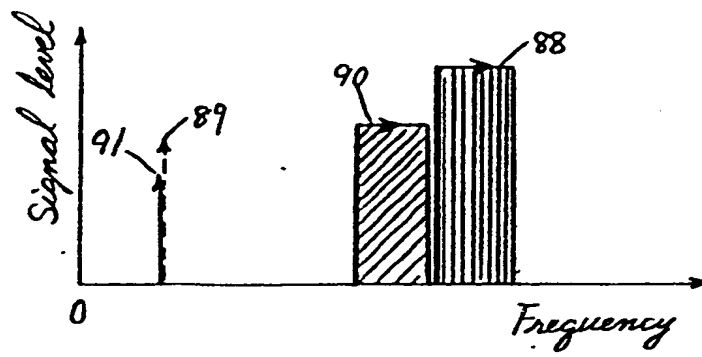


FIG. 17

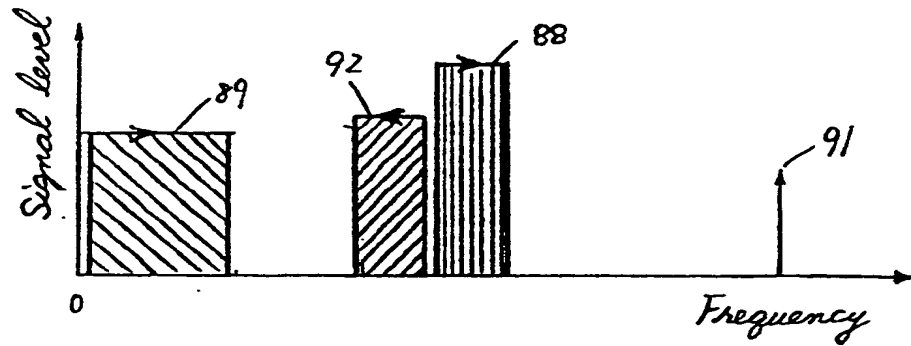


FIG. 18

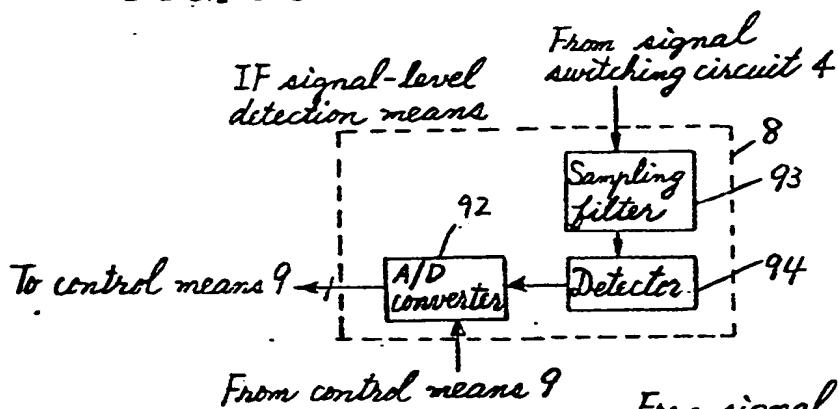


FIG. 19

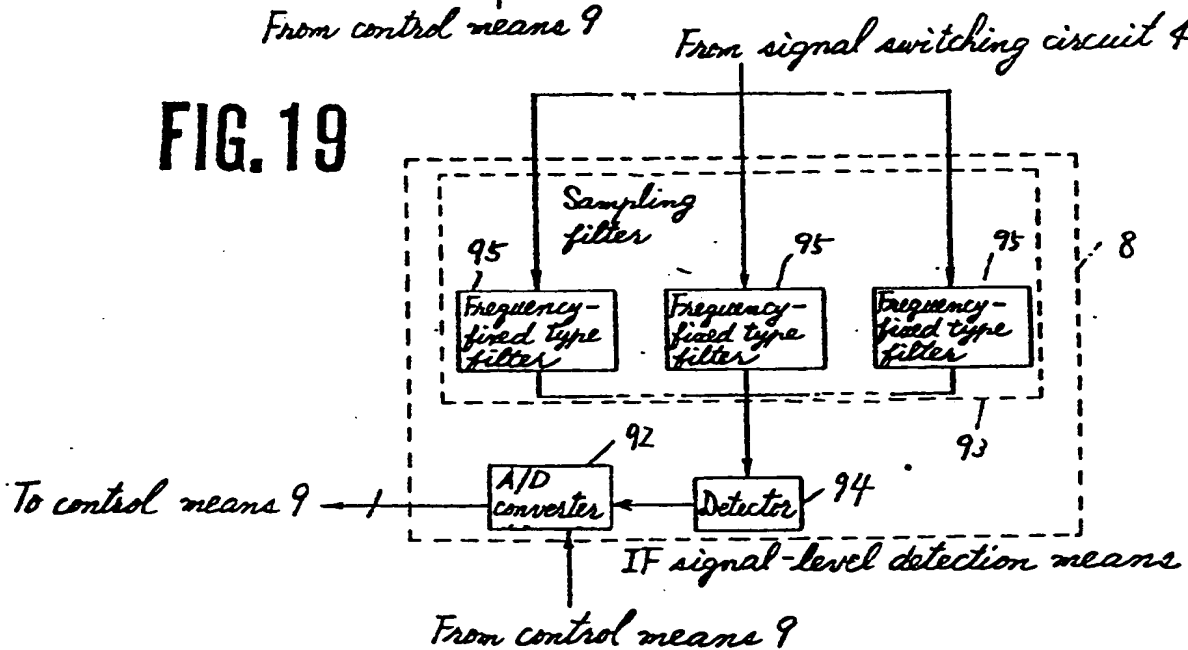


FIG. 20

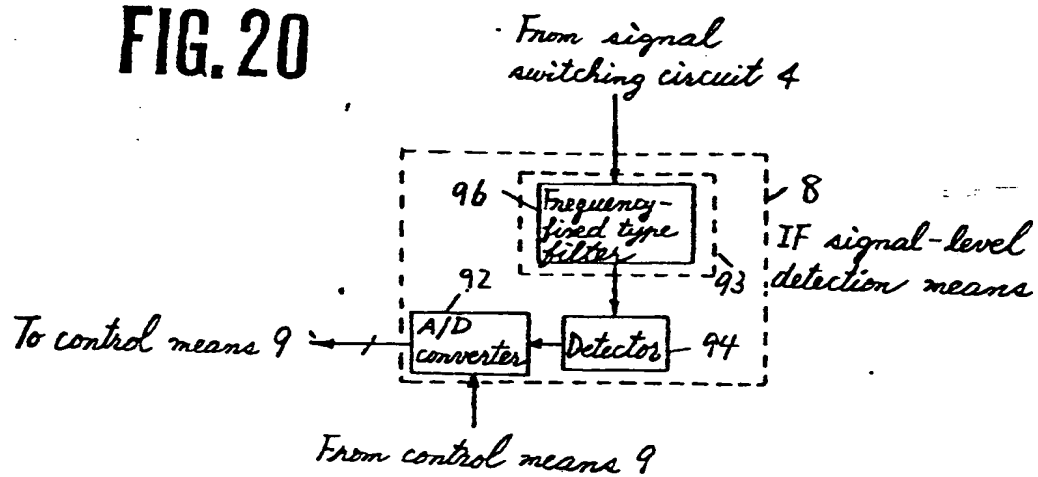


FIG. 21

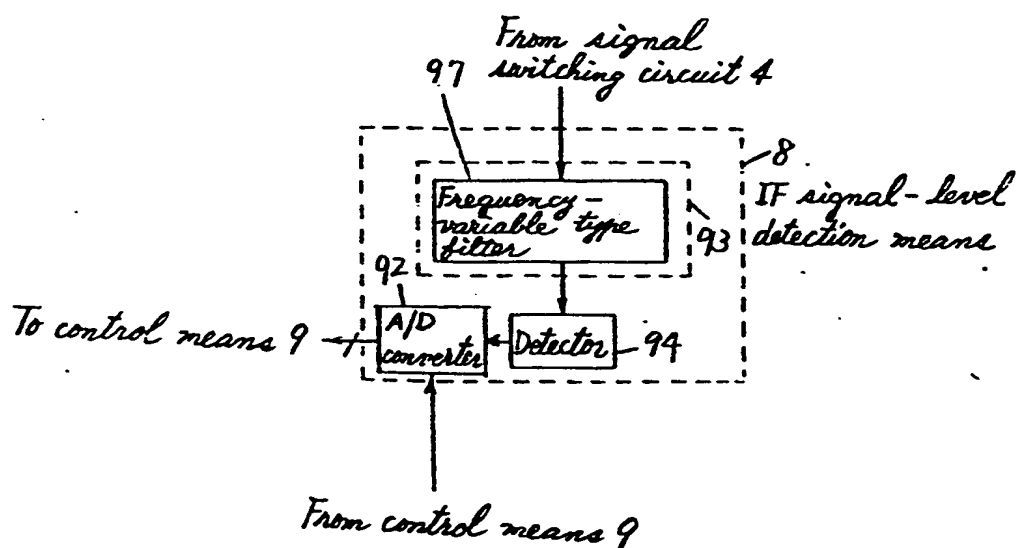


FIG. 22

13/20

0208470

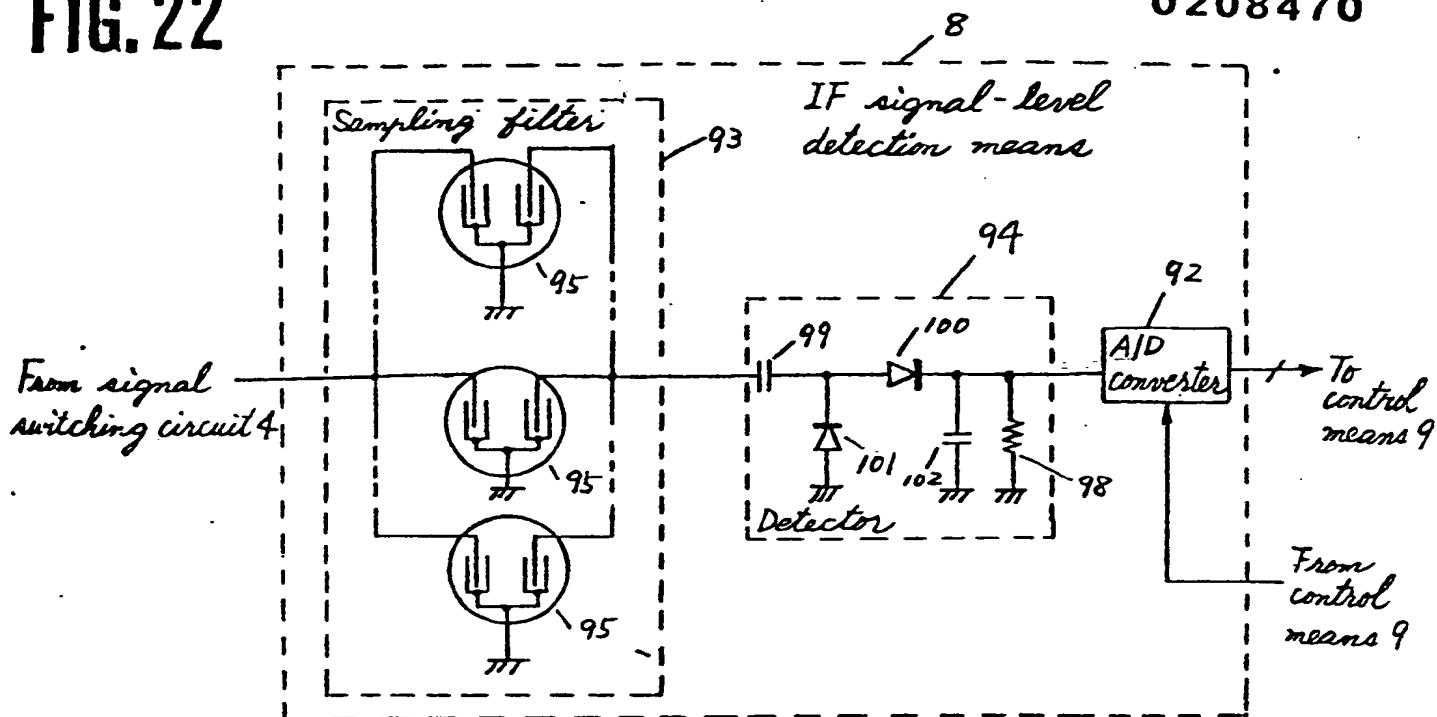


FIG. 23

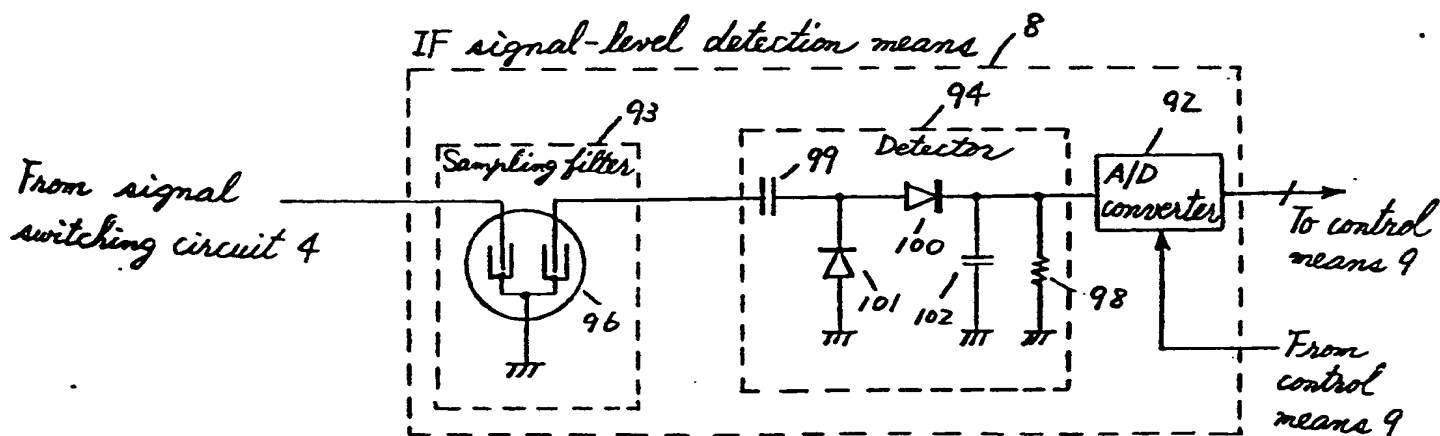


FIG. 24

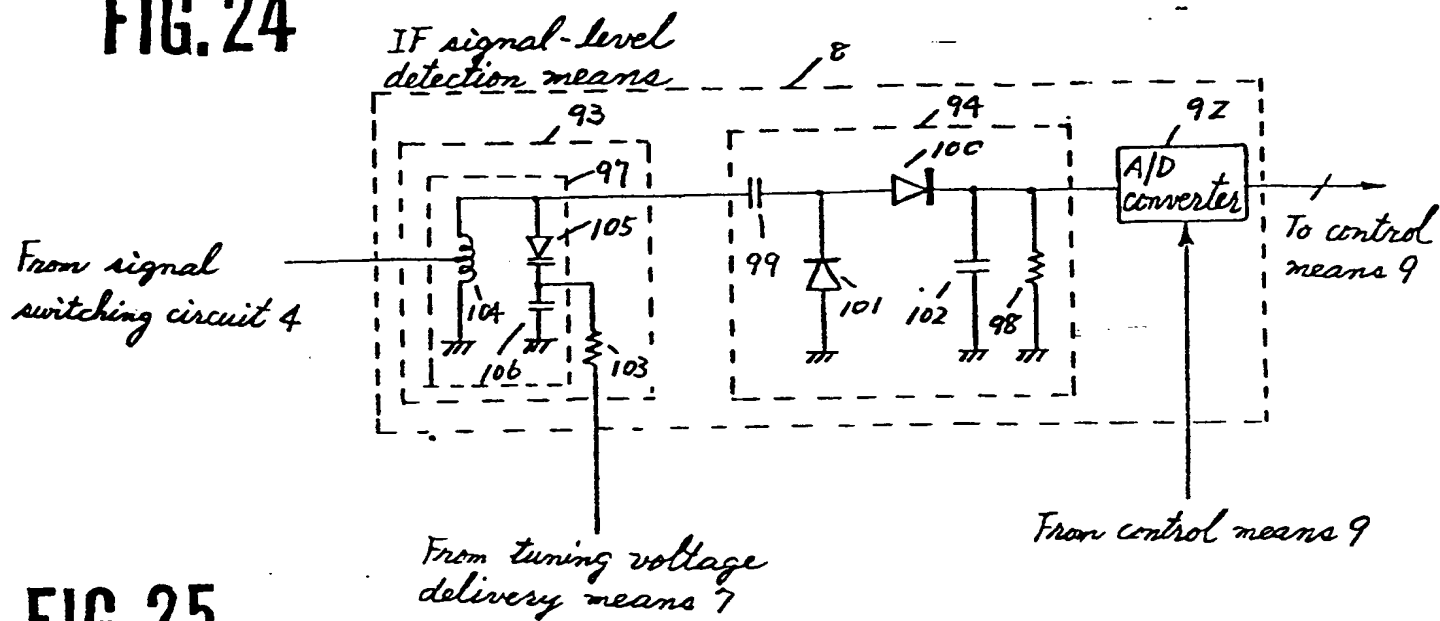


FIG. 25

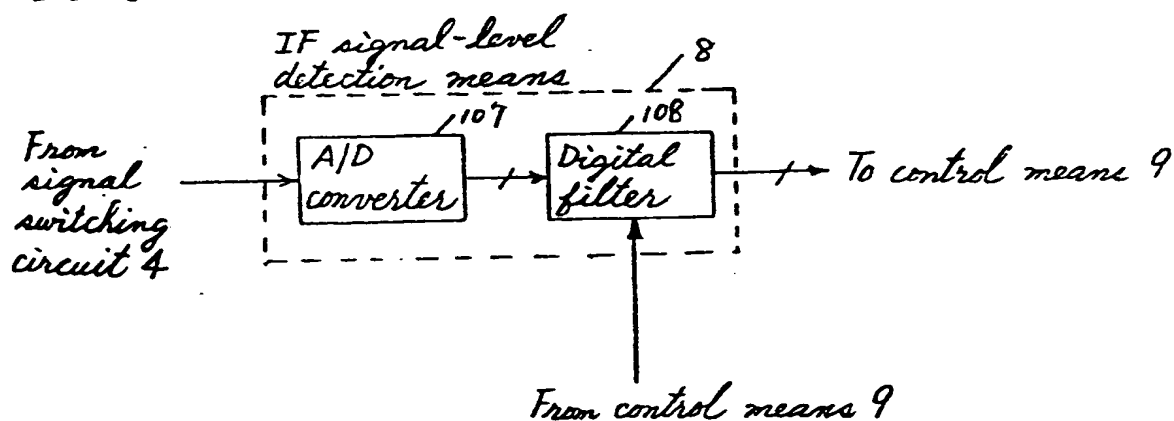


FIG. 26

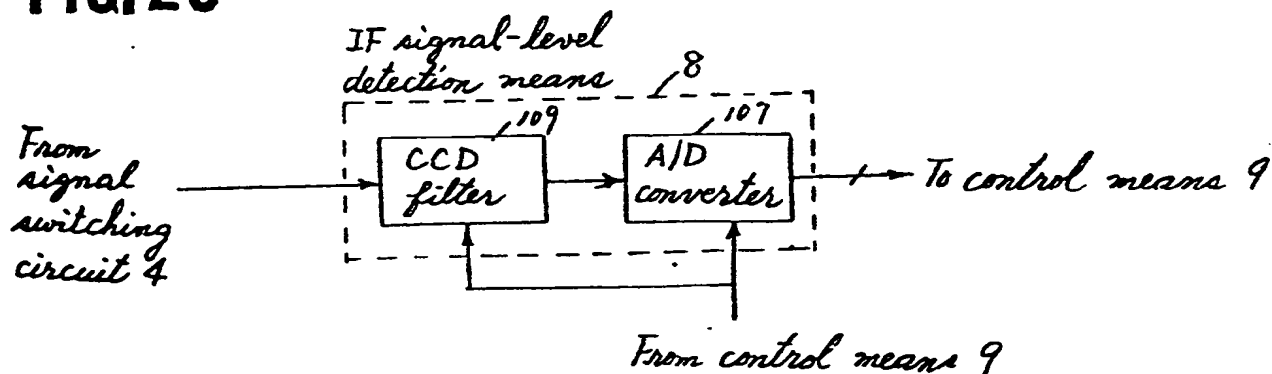


FIG. 27

15/20

0208470

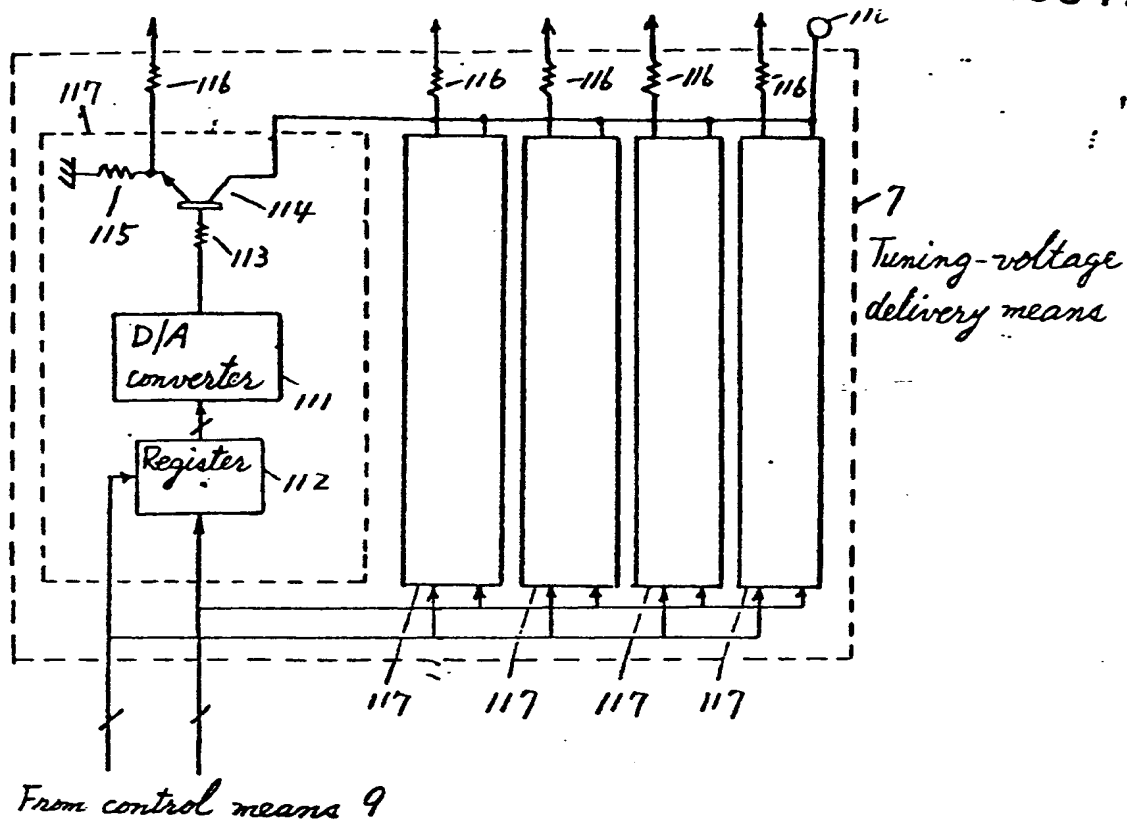


FIG. 28

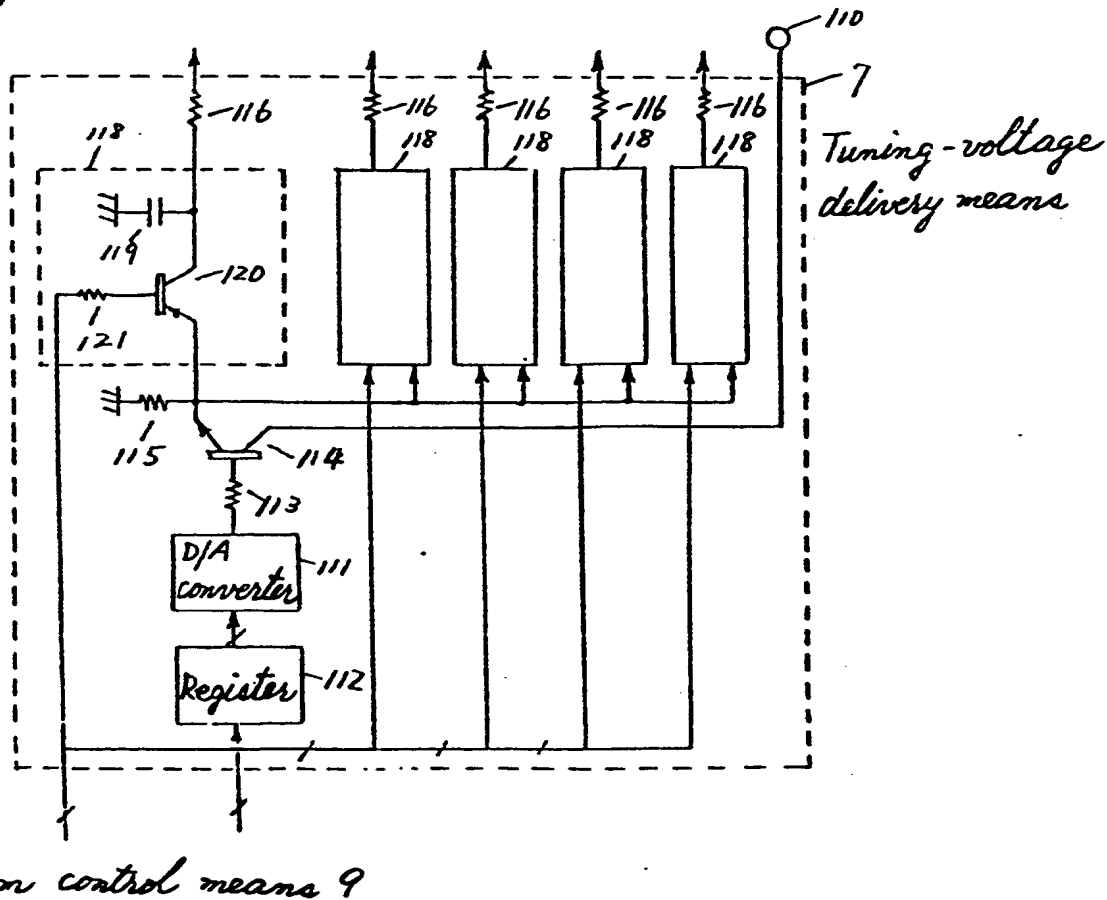


FIG. 29

0208470

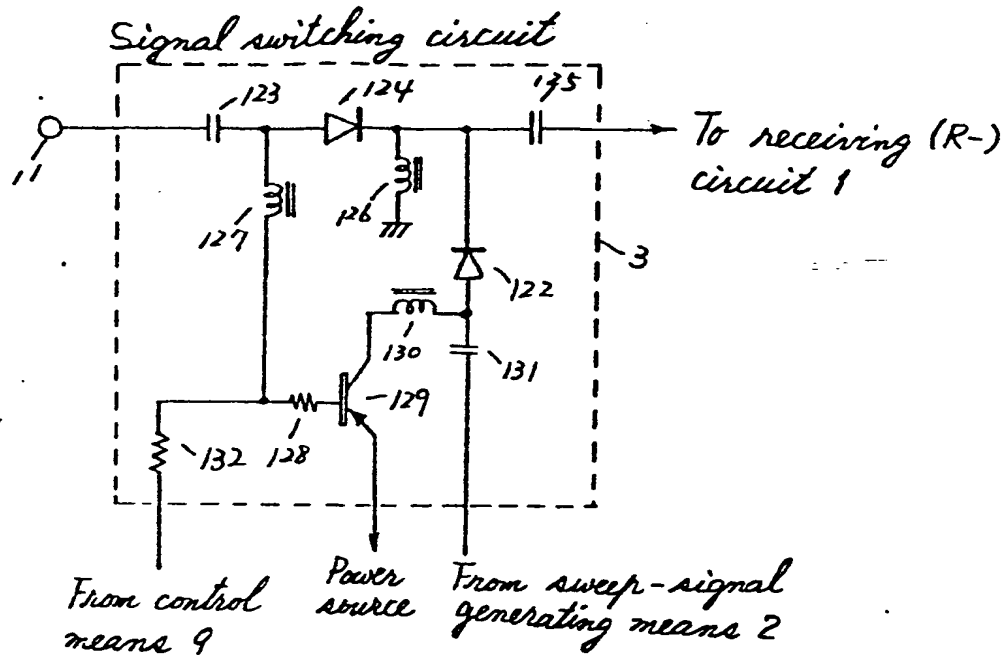


FIG. 30

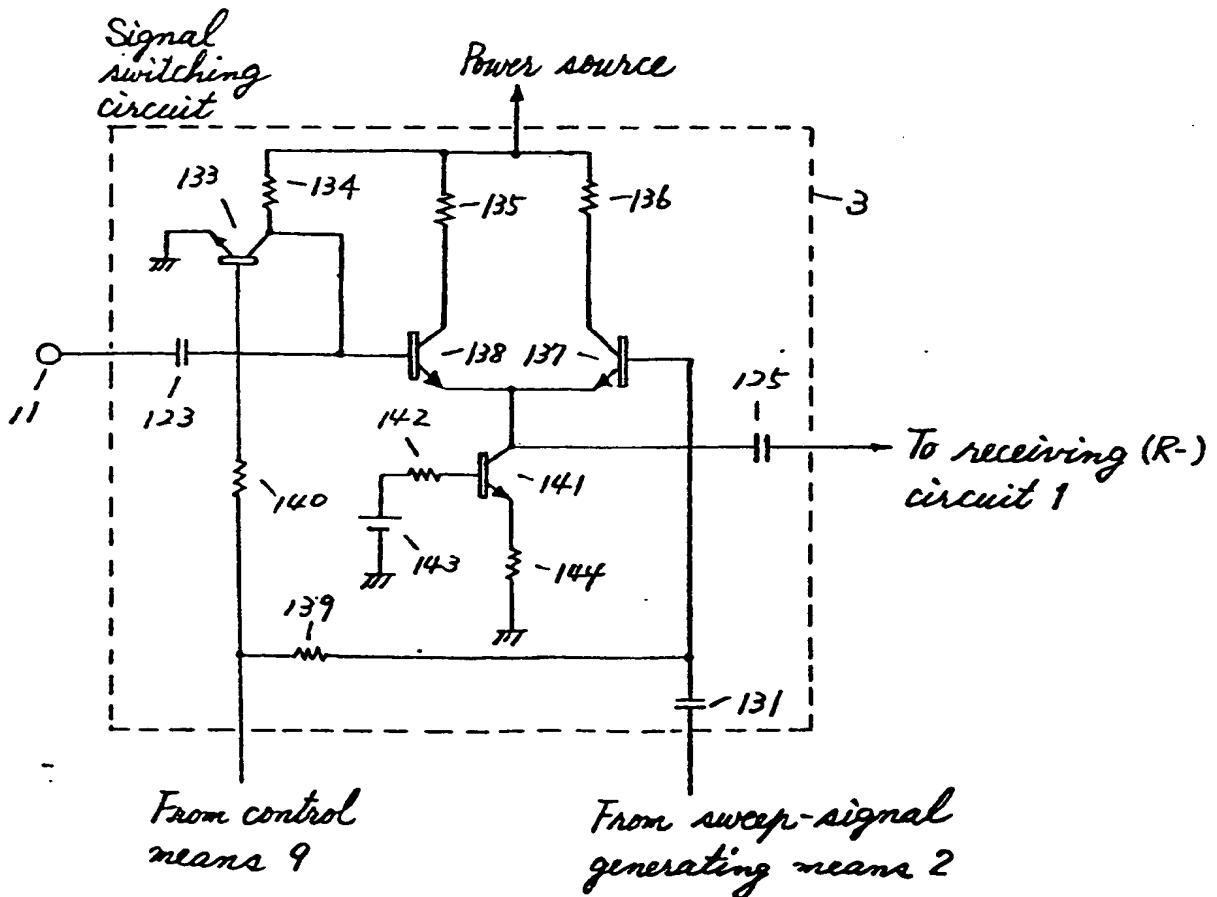


FIG. 31

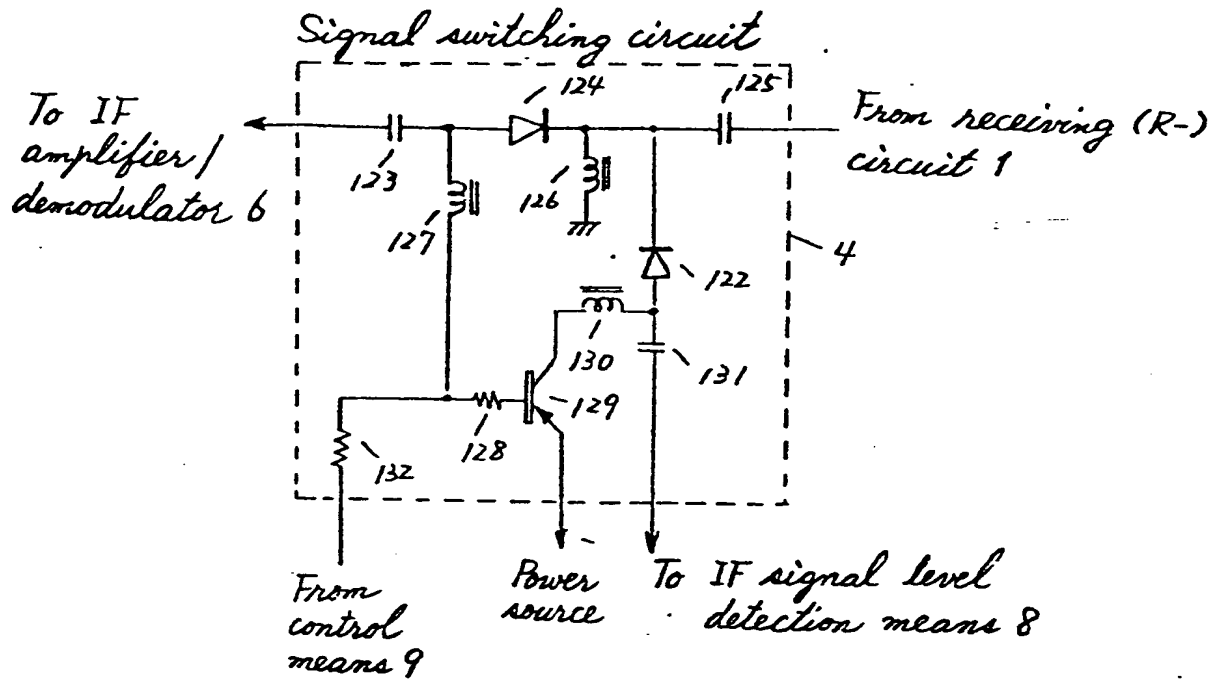


FIG. 32

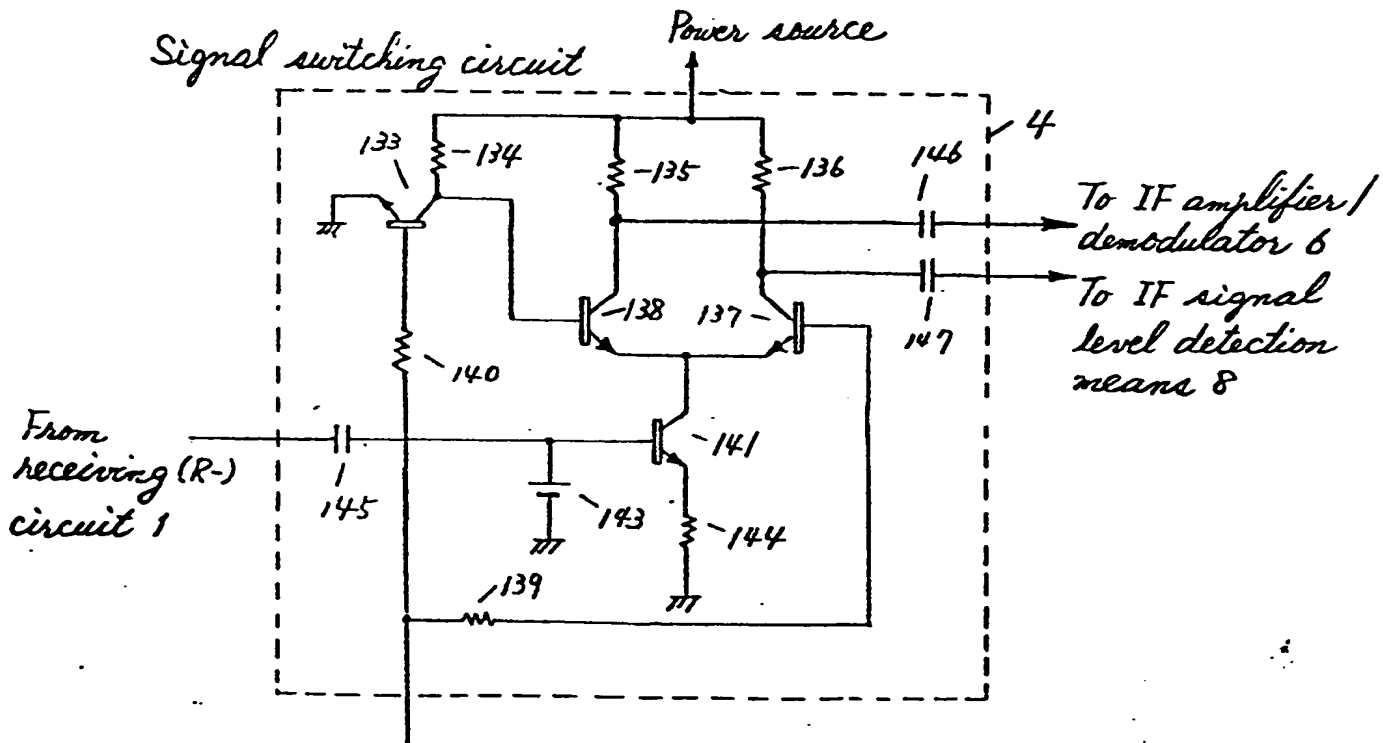


FIG. 33

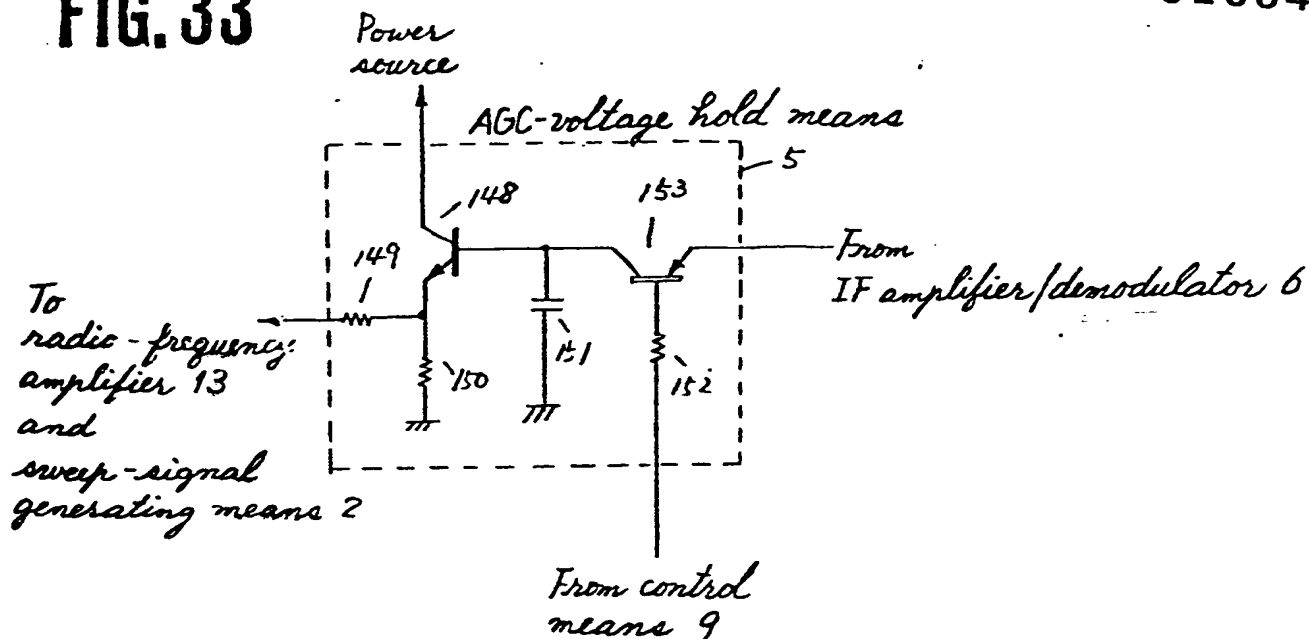
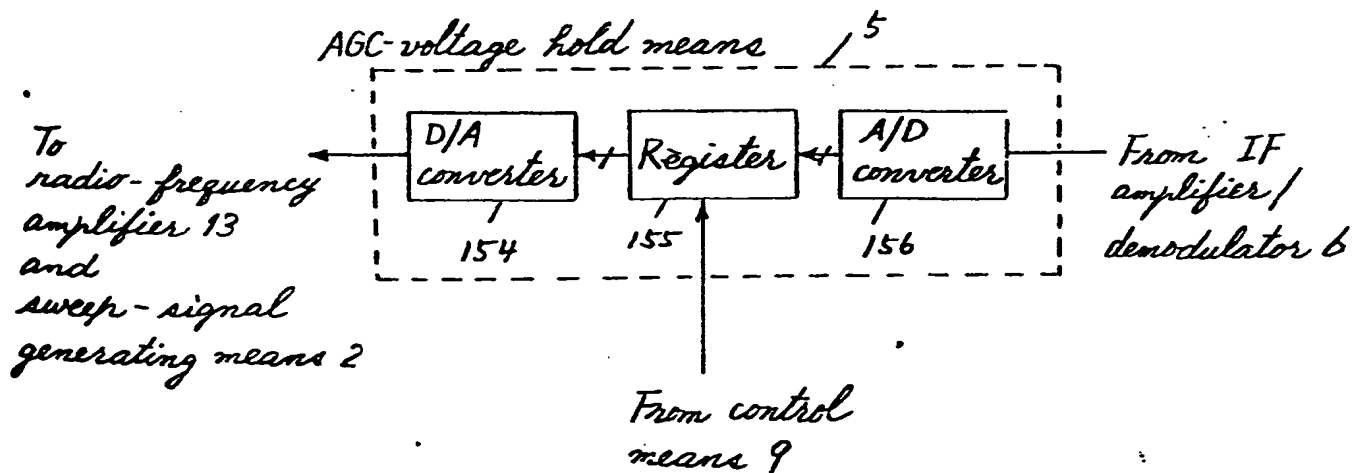


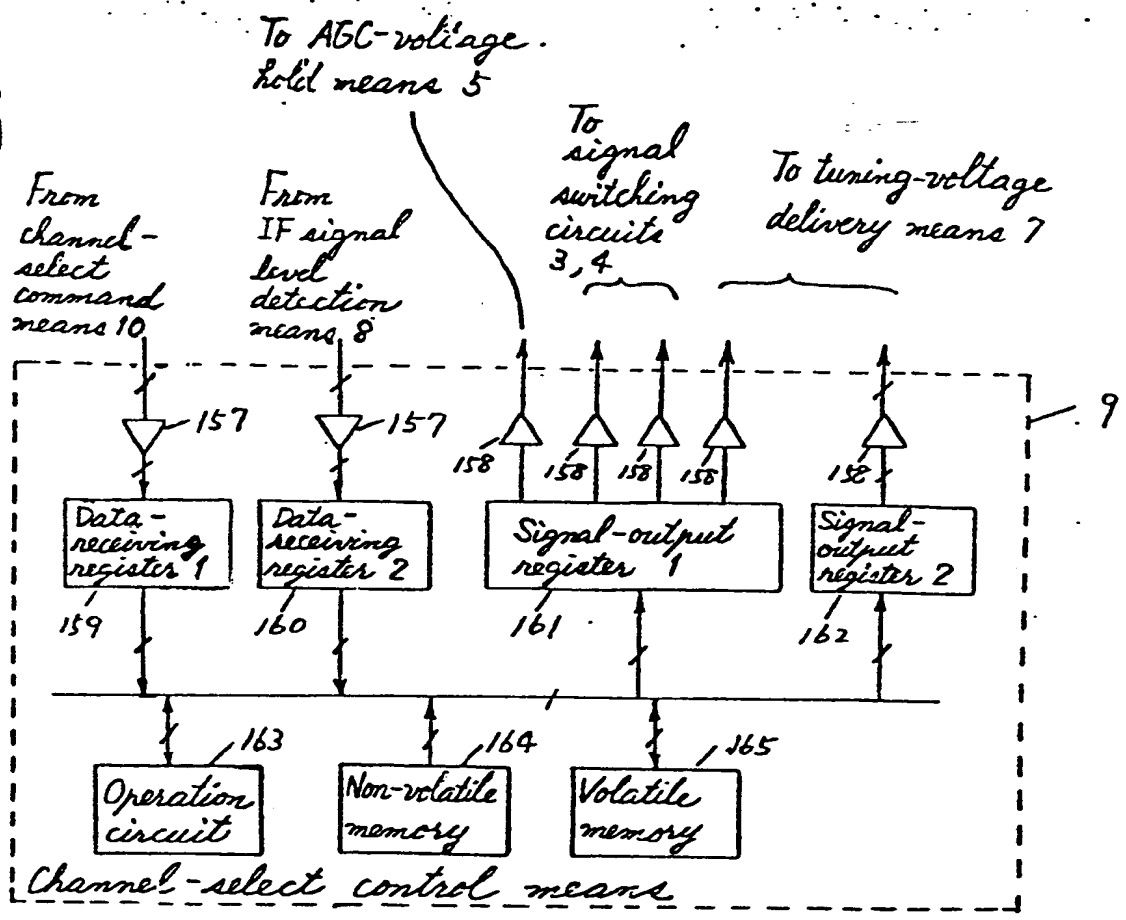
FIG. 34



19/20

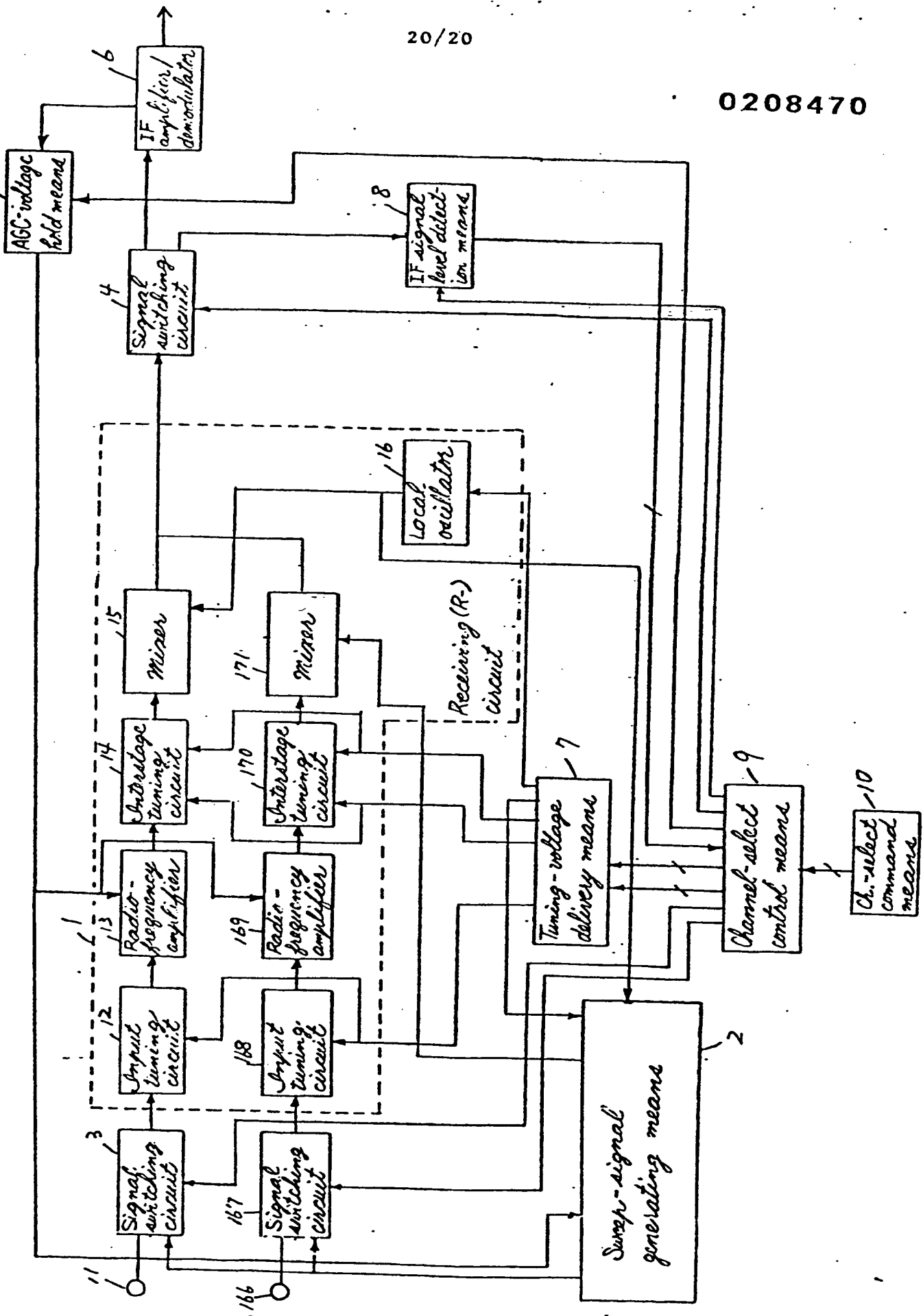
0208470

FIG. 35



0208470

FIG. 36



(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number:

0 208 470
A3

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 86304933.4

(51) Int. Cl.³: **H 03 J 5/02**
H 03 J 7/18, H 03 J 3/06

(22) Date of filing: 25.06.86

(30) Priority: 02.07.85 JP 145505/85
02.07.85 JP 145513/85

(43) Date of publication of application:
14.01.87 Bulletin 87/3

(88) Date of deferred publication of search report: 14.12.88

(84) Designated Contracting States:
DE FR GB

(71) Applicant: Matsushita Electric Industrial Co., Ltd.
1006, Oaza Kadoma
Kadoma-shi Osaka-fu, 571(JP)

(72) Inventor: Sakashita, Seiji
1-B40-405, Otokoyamaishishiro
Yawata-shi Kyoto-fu, 614(JP)

(72) Inventor: Fukui, Kiyotake
15-2, Higashisyoujaku
Settsu-shi Osaka-fu(JP)

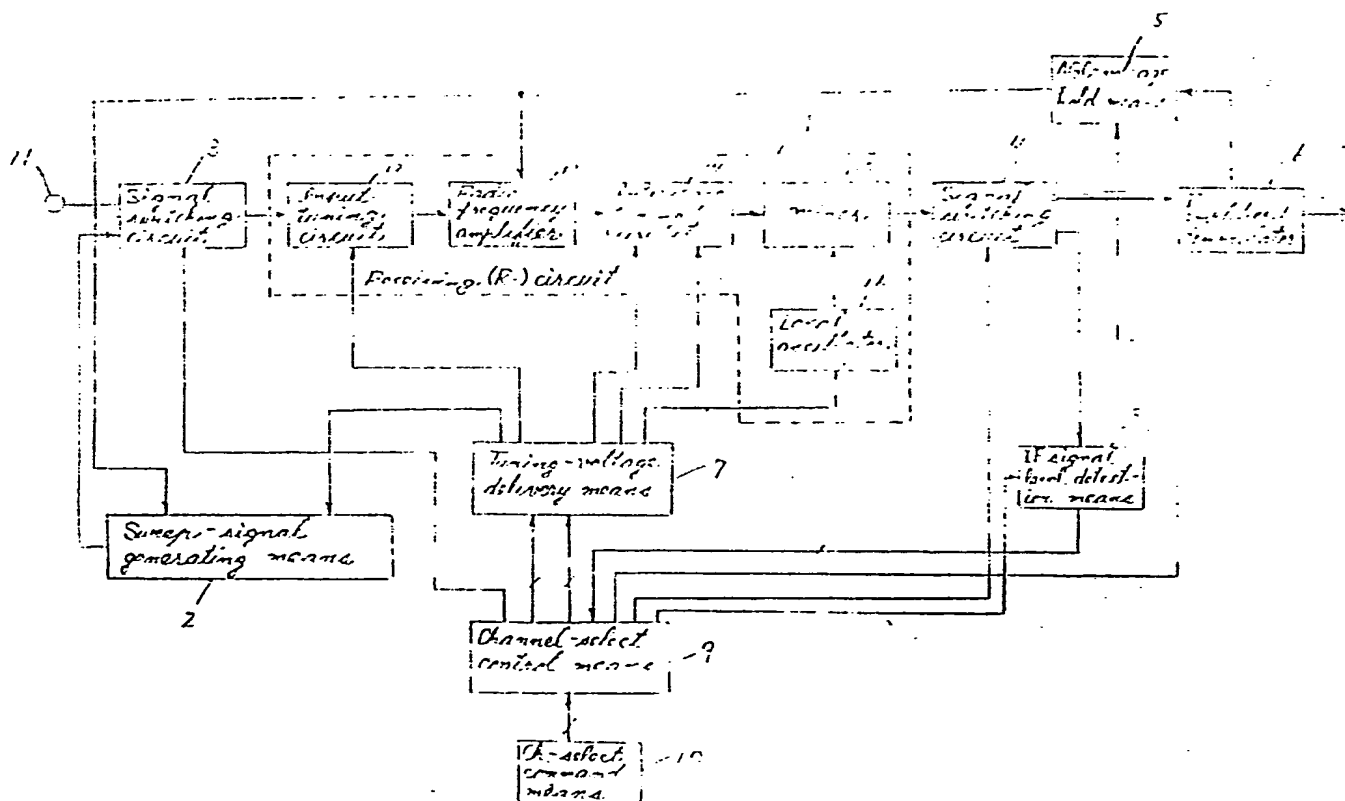
(74) Representative: Crawford, Andrew Birkby et al,
A.A. THORNTON & CO. Northumberland House 303-306
High Holborn
London WC1V 7LE(GB)

(54) Signal receiver with tuning circuits.

(57) A signal receiver comprises a sweep signal generating means (2) which generates a reference signal having a frequency swept over desired channel bands. The reference signal is applied to an input terminal of the receiver unit via a signal-switching circuit (3) that performs switching between the desired-channel signal and the reference signal. The signal strength is detected for plural frequencies of the reference signal, and after storing the detected signal data in memory, the signal receiver compares the detected signal data to the aimed frequency characteristics. Then, the tuning voltages for respective tuning circuits (12, 14, 16) are determined so that the difference of the comparison is minimized. After determining the tuning voltages, these voltages are delivered to respective tuning circuits, and the input of the receiver is switched from the reference signal to the desired channel signal.

EP 0 208 470 A3

./...





European Patent
Office

EUROPEAN SEARCH REPORT

0208470

Application Number

EP 86 30 4933

| DOCUMENTS CONSIDERED TO BE RELEVANT | | | |
|---|---|--|--|
| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl. 4) |
| A | WO-A-8 402 236 (DEUTSCHE THOMSON-BRANDT GmbH) * Figure 1; page 4, line 1 - page 6, line 3 * | 1 | H 03 J 5/02 H 03 J 7/18 H 03 J 3/06 |
| A | ELEKTRONIK, vol. 33, no. 9, 4th May 1984, pages 23-24, Munich, DE; M. ENGLMEIER: "Mup gleicht TV-Tuner ab" * Whole article * | 1 | |
| A | DE-A-2 856 397 (LICENTIA PATENT-VERWALTUNGS-GmbH) * Figure 2; page 14, line 23 - page 16, line 14 * | 1 | |
| | | | TECHNICAL FIELDS SEARCHED (Int. Cl. 4) |
| | | | H 03 J |
| The present search report has been drawn up for all claims | | | |
| Place of search THE HAGUE | | Date of completion of the search 03-10-1988 | Examiner RATAJSKI |
| CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document | | | |

EPO FORM 1503 01.82 (P0401)

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKewed/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.